THE

AMERICAN NATURALIST.

Vol. VI.—FEBRUARY, 1872.—No. 2.

THE MOUNTAINS OF COLORADO.*

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Topographical Features.—The mountains of Colorado form, perhaps, the most striking feature in the orology of the United States. Regarding the several ranges which traverse the region between Mexico on the south and the British Possessions on the north as parts of one stupendous whole, whose upheaval in the main may be referred to one geological epoch, we find that along the fortieth parallel the most active telluric forces were exerted, producing the widest expansion and culminating in the loftiest peaks. Between the Sierra Nevada on the west and the Wasatch on the east, the ridges, with their intervening valleys, reach an expansion of not less than a thousand miles. Traced north and south they not only diminish in height but contract in width to about four hundred miles. There are five or six peaks in Western Colorado which attain an altitude of over fourteen thousand feet above the sea, constituting the highest ground in the United States, with the exception of a region on the head waters of Kern River where there is a single point, Mt. Whitney, estimated at fifteen thousand feet.

Between the Missouri River and the Rocky Mountains there is a great swelling of the land, which to the ordinary observer is al-

* Read before the Chicago Academy of Sciences, November 14, 1871.

most imperceptible. Kansas City, at the junction of the Missouri and Kaw Rivers, is six hundred and forty-eight feet above tide water; First View, near the western line of Kansas, is four thousand, four hundred and seventy-nine feet; and Denver, fourteen miles from the base of the mountains, is five thousand, one hundred and five feet. Thus it will be seen that the traveller along this route is ascending a rapidly-inclined grade which to the eye appears as a dead-level.

From this elevated plateau the mountains rise abruptly, like a great rampart, ridge succeeding ridge, until, on the fortieth parallel, the culminating point is attained at Gray's Peak. This peak was named in honor of the distinguished botanist of that name, by one of his devoted disciples, Dr. Parry, who was the first to measure its altitude, which he found to be fourteen thousand, two hundred and forty-five feet.

There are really two culminating points to the range in this vicinity; one with a rounded outline probably a few feet lower, and the other cone-like in form, which in the distance resembles an aërial pyramid. It would not be inappropriate to attach to the southern point the name of Torrey, who has done so much in determining the botany of the mountain region of the United States; thus linking together the names of two honored observers who throughout a series of years have worked side by side in a common science. Here is the water-shed of the continent. The rains which fall on the western slope find their way to the Pacific through the Colorado River and the Gulf of California, and those which fall on the eastern slope reach the Atlantic through the Platte branch of the Missouri, thence through the Mississippi and the Gulf of Mexico.

Standing at Denver on a clear summer's day, the observer comprehends in the range of his vision, a view rarely surpassed in grandeur and extent. The mountains rise abruptly from the plains like a great wall which can be traced for one hundred and fifty miles. To the south is seen Pike's Peak, distant sixty miles or more, jutting into the plains, and to the north, nearly equidistant, Long's Peak, with its snow-clad flanks and bare scalp, looms up amidst the congeries of peaks. The intermediate distance is filled in with mountains of every variety of contour; some serrated, some crater-like, some pyramidal and some with rounded outlines.

The best time to view this landscape is at early morn. The mountains then resemble a great cloud-bank hanging on the verge of the western horizon. As the sun comes up illuminating the peaks and projecting crags, the landscape resolves itself into definite outlines. Over the whole are thrown broad masses of light and shade, and rock and tree and grassy slope are revealed with wonderful distinctness, while from the snow-fields are flashed back the tints of sapphire and gold. Bathed in that rare and clear atmosphere there is something in this scene ideal, unearthly. "The Delectable Mountains" revealed to the vision of John Bunyan were not comparable in grandeur to these.

While in the distance, the mountains appear to present an impenetrable barrier, yet when approached, they are found to be intersected by numerous cañons which afford practicable routes to their very heart, and enable the explorer, without exhausting effort, to scale their loftiest summits. Their arrangement *en echelon* affords passes which may be surmounted even by railroads.

We have, very properly, incorporated into our vocabulary the Spanish term "cañon" as expressive of a torrent-stream walled in by mountains. Such is the character of all the streams which descend to the plains. Rock-bedded and often rock-walled, they rush and roar in their onward course, and only find repose after their escape to the broad undulating plains.

Ascending a summit from which a bird's eye view of the country can be obtained, the contour of the surface appears like a confused mass of matter thrown up and corrugated when the elements of fire were in the wildest commotion. A tumultuous sea, instantaneously arrested and petrified, would be a miniature representation of what is here seen; and yet, when the geologist comes to carefully examine the structure of the mountains stratigraphically, he finds that they range in nearly conforming lines, whose direction is N. N. W. and S. S. E.

Another striking feature in the topography of this region is the series of high table-lands known as "parks." They are verdant valleys walled in by snowy mountains. The melting snows give rise to numerous springs and rivulets which sustain an almost perennial growth of bunch grass, making these parks according to Fremont "the paradise of all grazing animals," and these streams the favorite abode of the speckled trout. The antelope, the elk, the mountain sheep and the black-tailed deer still abound

in these rich pastures, but the buffalo has been driven away. When, in 1844, Fremont visited the South Park, herds of these animals blackened the surface, and their well-beaten trails afforded the most practicable route through the region; but now they do not even approach the foothills.

The Utes use these parks during the summer as cow lodges, but as winter approaches the herd is driven down to the plain.

Geology. To comprehend the geology of the Rocky Mountains, where the forces of metamorphism have been so powerfully exerted, it is necessary at the same time to study the geology of the Plains, where the strata repose nearly horizontally, and are abundantly charged with fossils. Starting at Kansas City, we first encounter the Coal Measures, which continue to Fort Riley. Here occurs a drab-colored limestone associated with marls, which is regarded as the equivalent of the Permian. Next succeeds a series of bright red and green marls, seen at Salina, which may be Triassic. Above this formation comes the Cretaceous occupying a broad zone nearly coterminous with the plains, conspicuously displayed at Ellis, Fossil Creek, and Fort Wallace. The Miocene-tertiary abuts against the foothills and extends to the east of Denver. At Golden City, the strata of this formation are tilted up vertically, thus showing that within comparatively recent times, this region has been subjected to violent displacements. It is characterized by heavy deposits of coal (lignite) which is successfully mined at Golden City, on Ralston's Creek, South Boulder and other streams descending from the mountains. The beds are from ten to fourteen feet thick—an undue expansion which would indicate that they are pockets, instead of persistent seams. The coal is bright and glossy, but crumbles on exposure to the air, and even when burned in a grate. It contains from twelve to fifteen per cent. of hygrometric moisture which must be expelled in combustion at the expense of the fixed carbon, and therefore prevents it from acquiring that concentrated heat necessary in metallurgic operations. It answers well for household purposes and for locomotives, and in such a region where wood is scarce, its economical value can hardly be over estimated.

As we enter the foothills, layers of brick-red sandstone are observed which, although destitute of fossils, Hayden is disposed to regard as Jurassic. There is also seen a drab-colored limestone,

used at Denver for building purposes, which Hayden regards as Carboniferous. Although ripple-marked, I observed no fossils. Both of these deposits are highly metamorphosed and the strata stand nearly vertical.

Next succeeds a vast series of gneissoidal rocks in which feldspar and mica are the predominant minerals. These rocks everywhere show lines of bedding, but they have been plicated, shattered and tilted up at all angles, and at the same time are cut by numerous divisional planes. The metamorphism of the mass is so complete as to have obliterated all traces of fossils and to have changed the mechanical structure of the rocks themselves. Perhaps there is no region on the continent where the action of igneous causes is displayed on so grand a scale as here.

The true granites are only seen along the axes of elevation. They play an important part in the structure of the region, constituting, as it were, its framework.

In the Rocky Mountain system is probably represented the whole assemblage of formations from the Azoic up to and including the Jurassic, but so thorough has been the processes of metamorphism, at least on the Atlantic slope, that it is impossible to recognize subordinate groups. On the western slope, Fremont long ago recognized rocks with organic remains, which he referred to the Oölite, which is a member of the Jurassic. The investigations of Whitney in California have settled this question — that it was at the close of the Jurassic epoch that this vast assemblage of formations was metamorphosed and folded into great ridges with their intervening valleys. The eruptive rocks accompanying this upheaval were for the most part granites, probably in a pasty condition, as in this association there are no traces of volcanic products.

Vein Phenomena. — It was at this time that the granites and metamorphic rocks became impregnated with the precious metals, such as gold and silver, which are found concentrated in veins and fissures. At a subsequent date — during the earlier Tertiary Period — a series of volcanic vents were formed along the line of previous disturbance, from which were poured forth a series of igneous products, such as basalts, lavas, etc. These also became impregnated with the precious metals, of which the famous Comstock lode in Nevada, as shown by Richthofen, is a notable example. Thus,

then, the formation of the mineral veins of this region may be referred to two distinct epochs.

The veins of Colorado, thus far mined, belong to the older class. The gold-bearing veins, unlike those of California, contain in their gangues, copper and iron pyrites, blende and galena, and so intimately is the gold connected with these sulphurets, that great loss is incurred in its extraction.

The veins of silver have, also, their associations of base sulphurets, and the silver itself appears under the forms of sulphuret and antimonial. Black Hawk and Central City are the main sites of gold mining, while Georgetown is the focus of silver mining. The annual product in the precious metals as estimated by Clarence King is about three million, two hundred and fifty thousand dollars. As constituting a part of the volcanic phenomena, may be mentioned the frequent occurrence of hot springs throughout the whole area occupied by this mountain system. In Colorado, the most noted are those of Middle Park and Idaho. The former are not readily accessible, and I am not aware that their waters have been subjected to analysis. The latter are now resorted to for their remedial virtues in cases of rheumatism, paralysis, and cutaneous affections. These springs issue from the left bank of Soda Creek, and are three in number. The flow is not copious, being about ten gallons a minute. The temperature is 109° F. An analysis of the water by Mr. J. G. Pohle of New York, gave one hundred and seven grains of solid matter to the gallon, made up of the following ingredients:

Carbonate of Soda,	30.80
Carbonate of Lime,	9.52
Carbonate of Magnesia,	2.88
Carbonate of Iron,	4.12
Sulphate of Soda,	29.36
Sulphate of Magnesia,	18.72
Sulphate of Lime,	3.44
Chloride of Sodium,	4.16
Chloride of Calcium and Magnesium, of each a trace,	
Silicate of Soda,	4.08
	107.08

Climate.—One of the most striking peculiarities of these mountains is the absence of a perpetual line of congelation. Mr. Bowles in his little work on this region, calls special attention to this significant fact, and points out the diversities between these mountains and those of Switzerland; and what I propose to state under

this head will be but an amplification of this train of thought. It is true that in midsummer even large snow-fields are to be seen, but it is the result of the winter's accumulation in the ravines and other places sheltered from the sun. Above the snow-patches the grasses thrive and the delicate lichens in thin flat crusts adhere to the rocks which form the dominating peaks. The tree-line ascends to eleven thousand feet. Potatoes, beets and cabbages and the hardier cerealia, such as oats and barley, are successfully cultivated at nine thousand feet; at ten thousand feet flowers bloom, often sending forth their petals close by a snow-bank. Thus January and May are commingled. Thriving under such conditions is a wild columbine which clusters in large patches and bears a deep purple blossom fringed with white. This profusion of gaudy flowers arrested the attention even of the untutored savage, and the Utes gave to the plant the name of *idaho* or purple flower. The white explorers applied this name to a town, which they founded on the banks of Clear Creek in Colorado, and a band of miners swarming thence to a region farther north, carried with them this name, which subsequently became attached to a territory of the United States.

During the summer, day after day, the sun comes up without a cloud; but midday passed, there is an afternoon mist, often accompanied by thunder and lightning. At Denver the phenomena of gusts of wind and thunder and lightning are of almost daily occurrence, and yet without a drop of rain. During the month of July last, the precipitation was fifty-one one-hundreths of an inch. In the mountains there are "cloud bursts," when the rains fall in a cataract and filling the gulches sweep every thing before them.

The electrical phenomena often occurring during a storm on the summits of the mountains are most vivid, and dangerous to those caught in such exposed positions. There are authentic instances where the body becomes so surcharged with electricity that the hair stands out rigidly, and sparks are emitted from the person thus isolated when approached, and every metallic article becomes luminous.

Statistics as to the amount of rainfall in the mountains have not been collected, but at Denver it only reaches about thirteen inches during the year.

In that dry and bracing atmosphere the thermometer may rise to ninety degrees F. and yet without producing those depressing

effects experienced in a more humid climate. Perspiration is almost insensible. The residents represent that autumn is the pleasantest portion of the year, and that this delicious season continues until January, when the winter seriously sets in and continues until May. The snows are not deep, and on the cliffs exposed to the direct rays of the sun rarely remain over a few days. Such is the climate in the cañons, but on the higher peaks a mantle of white begins to form late in September and continues to accumulate until spring.

The temperature at Denver, two thousand, one hundred and five feet above the sea, does not differ essentially from that at Cambridge, Massachusetts, seventy-one feet above the sea, while the difference of latitude is about two degrees. This is shown in the subjoined table:

	Spr.	Sum.	Aut.	Win.	Mean.
DENVER.	45.6	69.0	39.9	30.3	46.2
CAMBRIDGE.	44.3	68.6	50.1	26.2	47.3
	1.3+	.4—	10.2—	4.1+	1.1—

Mt. Washington, in New Hampshire, is six thousand six hundred feet above the sea, and the little band of observers who last year passed the winter upon its summit, encountered all the rigors of an arctic climate. At Idaho Springs, in the heart of the Colorado Mountains, and one thousand one hundred and forty-two feet higher, cattle may pass the winter without shelter. A warm breath permeates the valleys, mitigating the severity of winter, and rendering the climate agreeable to the human system. I will not pause to discuss the causes of this anomaly, so at variance with what is observed in other regions lying within the temperate zone.

If we turn to the Alps, from which we naturally derive our ideas of the effects of temperature by reason of elevation, we shall find that far different conditions prevail. At the height of eight thousand feet the line of perpetual snow is encountered, and not less than four hundred glaciers exist, extending over an area of fourteen hundred square miles. Mt. Blanc, fifteen thousand, seven hundred and forty-four feet above the sea, about fifteen hundred feet higher than several of the Colorado Peaks, is scaled only by cut-

ting steps for a long distance in an icy acclivity, and its scalp is always snow-clad. The pines and larches disappear at five thousand, nine hundred feet, while the mosses and lichens continue up to the line of perpetual snow. The cerealia are not grown higher than three thousand, eight hundred, or four thousand feet, but in one sheltered place, Skala, barley ripens at five thousand, nine hundred and fifty feet above the sea.

In order to produce glaciers there must be a marked relief and depression of the surface and a marked vicissitude between the summer and winter temperature. While the Andes in the tropics rise into the region of perpetual congelation, there is not that variation of temperature which is necessary to produce *neve*, that aggregation of large crystalline facets, so different from river-ice, which make-up glaciers. Many parts of Siberia and North America are within the line of permanent ground frost, and yet no glaciers are formed. In the Alps, according to Forbes, the summer's thaw percolates the snow to a great depth with water. The frost of the succeeding winter penetrates it far enough to freeze it to at least the thickness of one year's fall; or by being repeated in two or more years, consolidates it more effectually. The glacier commences near the line of perpetual snow, and renewed by the accumulation of each winter descends to a lower level, its extremity being constantly dissolved by the summer's heat.

In the Colorado region the conditions of relief and depression of surface are sufficient to maintain glaciers, but the temperature is not sufficiently low to maintain a line of perpetual congelation on which they depend for their existence.

Glacial Action.—Two enquiries naturally suggest themselves; were these mountains formerly encased in ice? Were these plains subjected to that erosive action so conspicuously displayed in New England and the region of the Great Lakes?

The western limit of the Erratic block group, as observed by me, is in the immediate valley of the Missouri, between Leavenworth and Lawrence. The western limit of the striated rocks, as observed by Hayden, is at Plattsmouth, also in the immediate valley of the Missouri.

In crossing the plains, which expand to more than six hundred miles in width, there is an absence of all drift phenomena, such as boulders, gravel knolls, and planed surfaces, until Denver

is approached. Here the soil reposes on a water-washed gravel, but the beds of the streams are composed of shifting sands. Advancing towards the foothills, small boulders are observed strown over the surface, and occasionally it is traversed by ridges of sand.

In fact the observer experiences a feeling of disappointment at the absence of the more striking drift phenomena; for naturally comparing this region with the Alps, he expects to see great outlying masses of rock which have been transported far from the parent bed; accumulations of gravel and sand in the nature of terminal moraines; and rock surfaces which have been planed down and striated. Entering the mountains, the cliffs are jagged, no where exhibiting those smooth outlines seen in the Alps and called by De Saussure, *roches moutonnées*. The enclosing banks of the streams are made up of large egg-shaped pebbles and occasional boulders two and three feet in diameter. None of these materials, so far as I have observed, are *striated*, while the true drift pebbles are almost invariably marked by such signs. Taking Clear Creek as the line of my observation, these water-worn materials do not attain an elevation above its bed of more than one hundred feet, and tracing the smaller streams to higher elevations they soon disappear and are replaced by angular fragments.

The transporting power of the present streams is very great. They have a descent of from fifty to one hundred feet to the mile, and, swollen by the spring freshets, the waters sweep down with sufficient force to bear along the largest boulders here observed, particularly if entangled in ice.

Another phenomenon characteristic of all true drift regions, is entirely wanting on the plains, and but sparingly represented in the mountains; and that is the absence of lakes. Professor Ramsey, as far back as 1862, in a paper communicated to the Geological Society of London, pointed out the fact that lakes were very numerous in those regions where the evidences of ice action were most manifest, and comparatively rare in tropical and subtropical regions; and maintained that they were actually due to the erosion of their basins by glaciers.

The scenery of the Alps derives one of its principal charms from the abundance of its lakes. We may refer to Geneva, Constance and Zurich, near the borders of the mountains, to the Lakes of the Four Cantons, Lago Maggiore, and Como, and the

series of Austrian lakes, to say nothing of the innumerable pools of water which occur near the summits of the loftier ridges.

The scenery of Sweden and Norway is diversified by these inland enclosures of water, which become rare in the more temperate climates.

If we consult a map of the northern portion of our own country, we shall find that, leaving out the great chain of the Canadian Lakes, and such collections of water as Winnepeg, Athabasca, Slave Lake and Bear Lake, all the way from Minnesota to the Arctic Sea, there are innumerable smaller lakes which enable the voyageur in his canoe to penetrate to every portion of the country. In southern Wisconsin the lakes are few and in Illinois they disappear almost altogether.

On the plains there is not a permanent collection of water to which we attach the name of lake; and in the mountains they are rare. This is the more surprising when we consider how actively the forces of elevation and subsidence have been exerted. The Great Basin, it is true, is characterized by numerous lakes, most of which are of a highly saline or brackish character, but in a region where the streams are cut off from the sea, it is but natural that the waters should accumulate in the depressions.

There may have been a time when the annual precipitation of rain was greater, and consequently the transporting power of the streams was increased beyond their present capacity, but there are few phenomena with regard to the distribution of the superficial materials which cannot be explained by a resort to causes now in operation. Professor Whitney has arrived at substantially the same results with regard to the Pacific slope.

In concluding these observations, I may remark that the railroad facilities are now so far developed that to an inhabitant of the Mississippi Valley, this region is as accessible as the White Mountains of New England. The ordinary observer is brought in contact with some of the grandest scenes in nature, whilst to the geologist and botanist are opened new spheres of observation — a constantly recurring succession of the most interesting and varied phenomena.

IRRIGATION AND THE FLORA OF THE PLAINS.

BY E. L. GREENE.

THE system of irrigation is destined to effect some interesting changes in the aspect of the western plains in regard to their botany, as will appear from a few facts which we subjoin as the result of observations made in Colorado during the past two seasons.

It might be expected that refreshing streams conducted through this naturally rich, but extremely arid soil, would have flowery banks. So indeed it does sometimes happen, and so it would always be if the diggers of ditches would make them broad and shallow, with gradually sloping banks, instead of digging them narrow and deep and leaving the sides perpendicular.

God speed the labors of the "grim utilitarian;" for when he has plowed, and scattered the "precious seed," we know that with the wheat, there will spring up and bloom the purple corn cockle, and the yellow evening primrose — one joy for him and three for us. Or, if his skill divides the mountain stream, causing a portion of its waters to turn from their natural course adown the valley, and leads them over the thirsty plains that lie above, the happier are we; for while now from the face of the "desert" he reaps golden harvests, we see it "rejoice and blossom as the rose."

We will suppose that the reader is a botanist, and that he has come out from the far Atlantic shore, to pass a few summer weeks among the mountains. Arrived in Denver, the next point to be gained is Golden City, the gateway to the mountains. He might traverse this short distance in less than a half hour by rail, but of this mode of conveyance, excellent as it is, some three thousand miles, more or less, he is now doubtless tired; besides, he wishes to see something of the vegetation of the plains before leaving them for the rocks and the pine-forests, the alpine bogs, and the fields of perpetual snow. You then take this little trip to Golden City on foot. It is July or August. There has been no rain for these many weeks. The road is miserably dusty, but if you are on foot (or on horseback) you need not follow it, and the whole

surface of the plains is sere and brown save some "eighties" or larger tracts that are fenced, and under cultivation.

You have perhaps crossed a broad, deep canal of swiftly-flowing, muddy water, and now in passing these fields of grain you hear the laughing voices of little streams. They are hidden from view by the standing growth, and at proper distances from each other they go, singing on their way across the gently sloping fields, making glad the hearts of the ranchmen, with their sure promises of an abundant harvest. Now right in the midst of one of these "eighties" of wheat, you behold a solid-half-acre of—*can it be?* Yes, those are certainly the long strap-shaped leaves, and the dark cylindrical spikes of *Typha latifolia!* the veritable Cat-tail Flag; and growing more densely and luxuriantly than you ever saw it before.

It is difficult to harmonize, in your mind, this patch of marsh with its close surrounding of thrifty grain, and equally difficult is it to reconcile the whole field with what seems to shut it in on all sides *i. e.* a seeming boundless, lifeless waste of withered prairie grass. There are now, on these plains, many acres of Cat-tail Flag where five years ago, no seed of a marsh plant would have germinated, because all was then more like an African desert than an American swamp. The change came after the following manner. The large ditch was first made from some stream before it leaves the mountains, and led along the higher ground, whence its waters were conducted to these lands below, which now constitute fertile fields. After one or two seasons of irrigation, all slight hollows came to be occupied by shallow ponds. Why the surplus waters do not sink away into the earth beneath, you must learn from the geologist. The fact is they do not. Even during fall and winter when the water is turned off from the ditches, the ponds remain the same, the water in them falling but slightly below the ordinary level.

The gossamer-winged seeds of the Typha are borne upon the winds by the thousand, from the valleys of the rivers below, to these uplands. Here they find all circumstances favorable to germination, and the plants grow and spread rapidly; sedges and other marsh plants growing with them, and the whole comes in the course of a few years to bear a strong contrast to the almost desert tracts around.

In the settled, and consequently irrigated, portions of country

which lie nearest the foothills, where the landscape is considerably varied by elevations and depressions, there are now many larger lakes covering five or ten acres and quite deep, which were nothing more than dry hollows six or eight years ago. The number and variety of aquatic plants in these lakes are increasing every year, and on the shores of some the cotton woods and willows that have sprung up from seed are becoming quite conspicuous. In the section of which I speak, there are no natural lakes or ponds, but in those which have been the incidental result of the irrigation of the lands around them, the water-fowl, the amphibious reptiles, and strictly aquatic plants have all found for themselves homes in what was but a dry waste, a few years since. Some of the very oldest lines of ditches are now noticeable, at great distances by the native willows, which have sprung from seed and attained their full size, all along their banks. Otherwise the willows and cotton woods grow only in the mountains or by the rivers whose valleys lie considerably below the level of the plains.

Among the plants of the plains are a large class of annuals, the seeds of which seem invariably to germinate in autumn, and the plants, to attain half their growth during the fall and early winter, so that they flower in April and May. These are for the most part gone out of flower before the first of June, in all the uncultivated portions of the country; and during all the burning months of summer the seeds lie waiting for the rains of early autumn to start them into life. But not so upon the cultivated lands. Here, wherever moisture is given, there is a regular succession of these plants in bloom, through the whole summer and fall; and by the ditches at the side of our village streets, the botanist may in October gather excellent specimens of plants, which, before the settlement of the country, he would have found nowhere after May. The same may be said of many perennials, which, in the vicinity of the water, continue to send forth fresh stems and flowers, long after their season is past in other places.

THE FORMER RANGE OF THE BUFFALO.

BY JOHN G. HENDERSON.

Comparatively speaking it will be but a short time until the buffalo, like the great Irish elk, the mastodon, the dodo, and other extinct animals, that have lived since the appearance of man upon the earth, will only be known to us by its bones, with this advantage, however, over the mastodon; its character, habits and territory over which it formerly ranged are all accurately described by the historian and naturalist, as well as the causes which are leading to its extinction. As civilized man advances, the buffalo, the elk, the deer, the beaver, the otter, the bear, the panther, the wild-cat and wolf, and other members of the wilderness or prairie fauna, must give way to domesticated animals—animals whose original wildness and savageness have been subdued, and whose whole organization, mental and physical, has been by thousands of years of contact with civilized man modified and changed so as to become subservient to his wishes and purposes. Some, as the buffalo, elk and deer, are slaughtered for their flesh and hides; others as the otter and the beaver, for their skins alone; while still others, such as the panther, wild cat and wolf, are killed on account of their savageness, their existence being incompatible with the presence of civilized man.

For the buffalo are substituted our common cattle, for the wolf and wild cat, our domesticated dog and cat. Instead of clothing himself with the skins of the buffalo and deer, and living upon the fruits of the chase, the civilized man carries with him the sheep, from whose fleece he makes his coat for winter; or rears the cotton plant, while from its fibres he manufactures his fabrics, instead of fraying the inner bark of the cedar or basswood for the same purpose, as did the aboriginal man.

But civilized man in his march into the wilderness, or in his advance upon the prairies, meets with many new forms of animal life and from their number he now and then selects some, such as the wild turkey, for example, which seems to have a pre-adaptation to domestication, and from such he adds to the stock of his domesticated species.

But the advent of civilized man not only disturbs the native fauna by the extermination of large numbers of animals, but also by causing others to increase largely in numbers. When the enemy of any animal is exterminated or thinned out by any cause, such animal will rapidly increase in numbers. For illustration, the enemies of the smaller birds—the larger birds of prey—are destroyed by civilized man. This gives the small birds an advantage in the struggle for existence and they increase in numbers. It will thus be seen that the real amount of disturbance of the native fauna of the prairie or wilderness is not so easily comprehended as one would at first imagine.

The early Jesuit missionaries and French *voyageurs*, who by the way of the Great Lakes penetrated to the valley of the Mississippi, at the end of the seventeenth century, found the buffalo in thousands grazing upon the prairies of Illinois and neighboring states, or flying in countless numbers before the Red-hunter, or the prairie fire.

The idea of their domestication at once entered their heads, and, from that time to the present, many attempts have been made to domesticate them, or, by crossing with domesticated cattle, to impart to the latter some additional valuable quality; but I believe that hitherto all such attempts have proven abortive. Now and then, upon the western frontier, you may see the dun color, high shoulders, and somewhat restless disposition, that indicate a cross between the domestic cow and buffalo bull, but, like the red-blood of the Indian, the mighty throng that is pressing on, soon absorbs it, and obliterates effectually its marks, if not wholly its effects.

It was with a peculiar interest that I read the descriptions of these strange animals, transmitted home by the Jesuit or *voyageur*, who two hundred years ago first looked upon "our vast prairies on which herds of *wild-cattle* pastured in confusion." Strange contrast! Where now iron rails mark the highway of civilization and commerce, then were only paths made by the buffalo, or the Indian trail to hunting grounds or from village to village. Where now are great cities, built of brick, stone and iron, with their iron and marble fronted palaces of trade, then were Indian villages of sometimes five hundred cabins made of rushes sewed together by the hands of industrious squaws so ingeniously as to render them impervious to rain and snow, and so light

as to render it easy for the Indian woman to obey her dusky master when he ordered her to "take up her house and walk." Now huge boats, with gilded saloons propelled by powerful steam engines float on the bosoms of our rivers, then the light canoe made of the cotton wood log by the use of the fire and stone ax, or the still lighter birch-bark, were the only keels that had ever disturbed their waters.

As the sources of information of this character are not accessible to many readers of the NATURALIST, I may be pardoned for freely transcribing from accounts given in Jesuit letters and *Relations*, and from the pages of early French writers and *voyageurs*. Here we see old Illinois—as it was at the end of the seventeenth century—the otter, beaver, and wigwams upon the banks of its rivers, the panthers, wolves, bears and wild-cats in its forests, with its great prairies of wild grass where grazed the deer, the elk, and the buffalo, or at noon-tide shielded themselves from the summer's sun under the shade of lonely cotton wood trees, or in the beautiful groves that here and there studded the plain, like islands upon the bosom of the ocean. Here, too, we see primitive man hollowing out his boat by the aid of fire and the stone ax, skinning animals and dressing their hides with the flint knife, and engaged in war or the chase, armed with the war-club and bow, and whose arrows were tipped with bone or flint. Here are presented to our view the first effects of the contact of civilization and barbarism, we see the Indian eagerly exchanging skins of the buffalo and beaver, and other articles demanded by civilization, for the iron ax, knife, gun, and kettle, to supply the place of the stone ax, flint knife, bow and arrow, and Indian *akeek*. Here we see the gay and volatile French associating upon terms of equality with the Indian, each adopting the manners and habits of the other and thus assimilating the habits of civilized man with the superstitions and customs of the savage, for the "Frenchman forgot not that the uncivilized man as well as the civilized man, was his brother and he deported himself as man to man." Here we see the Jesuit, the medicine-man of civilization, struggling to displace the superstitious rites and ceremonies of the medicine-man of the forest, to substitute his own no less whimsical, foolish and absurd rites and ceremonies in their stead; and the triumph of the former, when, as on one occasion, after forty dogs had been sacrificed to appease the spirit of destruction,

which, in the form of disease, was laying waste the village, the medicine-man was forced to bow his knee to the cross and offer up his prayer for mercy to the great Manitou of the French. Here in these old Jesuit *Relations* and Letters we see the Red-man on bended knee before the blessed virgin, reciting the rosary or repeating *Ave Marias* translated into the Algonquin language by the Jesuit fathers.

The Jesuit missionary, Father Marquette, who, with Joliet and five French *voyageurs*, discovered and explored the Upper Mississippi, in the year 1673, was the first white man who penetrated to the habitat of the buffalo, by way of the Great Lakes. Father Claude Alloüez and other missionaries, who had penetrated the wilderness as far as *Che-goi-me-gon*, a great Chippewa Village at the extreme west end of Lake Superior, no doubt had heard from the wandering Sioux, or as they were known in those days, the Nadouessi, of the great plains that lay farther westward and of the vast herds of buffaloes that roamed over them. History, indeed, records the fact, that these Sioux Indians told the strange pale-faces that came among them with "pictures of hell and of the last judgment" of their manner of shielding themselves from the winter's storm with the hides of wild-cattle for the roof of their cabins instead of bark. It was here, too, that the missionaries heard of the Great River, and here, for the first time in history, appear those two Algonquin words, *Messi-Sepe*. Father Alloüez, in speaking of the Sioux Indians says, "They live on the great river called Messipi." He blended the adjective *Messi*, great, and the noun *Sepe*, river, into the word *Messipi*, which was no greater corruption of the original than our Missis-sippi. It was here, too, that Father Marquette received tidings of the Great River, and the nations that dwelt upon its banks, and it was here that he resolved to explore it. "This great river," he says, "can hardly empty in Virginia, and we believe that its mouth is in California. If the Indians who promise to make me a canoe do not fail to keep their word, we shall go into this river as soon as we can with a Frenchman and this young man given me, who knows some of these languages, and has a readiness for learning others; we shall visit the nations which inhabit it, in order to open the way to so many of our fathers who have long awaited this happiness." *

At the same Chippewa Village, the Jesuits met the *Illinois* Indi-

* Marquette's Letter to Le Mercier.

ans, who came there to rehearse their sorrows and ask the protection of the French. The Sioux upon the one side and the Iroquois upon the other, had made savage inroads upon them. They told of the noble river upon which they dwelt. "They had no forests, but instead of them, vast prairies where herds of deer and buffalo, and other animals, grazed on the tall grasses." This is the first mention that is made of the buffalo upon the prairies of Illinois. None of the French had yet seen the buffalo unless, perchance, some trader had followed the Indians to their hunting grounds, though many thousands of robes had already been transported from the region of the Upper Mississippi to Europe. They were taken from the buffaloes by Indian hunters, tanned and prepared by the hands of the squaws, and then in birch-bark canoes, transported by way of the western rivers to the *portages*, where canoe and cargo were carried across to the head waters of rivers that emptied into the Great Lakes, over whose waters, still in the birch-bark canoe, they were carried to Quebec, and there by their Indian owners, exchanged for articles of French manufacture suitable to the wants of savage man.

Father Marquette says of the Illinois, "They always come by land. They sow maize which they have in great plenty; they have pumpkins as large as those of France, and plenty of roots and fruit. The chase is very abundant in wild-cattle, bears, stags, turkeys, duck, bustard, wild-pigeon and cranes. They leave their towns at certain times every year to go to their hunting grounds together, so as to be better able to resist if attacked. They believe that I will spread peace every where, if I go, and then only the young will go to hunt."*

It was not, however, until the fall of the year 1672 that he received orders from his superiors "which bid him embark at last upon the voyage so long and fondly projected."

Louis Joliet, whose name is now imperishably connected with that of Marquette in the discovery of the Mississippi River, arrived in the spring of 1673, with orders, from Comte de Frontenac, governor of Canada, and M. Talon the intendant, for the exploration of the great river.

The winter before the arrival of Joliet was spent in busy preparation for the great voyage. From the wandering Indians Father Marquette gathered all the information he could, and from their

* Ibid.

statements he drew the first rude map of the Great River, and marked upon it the names of the nations that dwelt upon its borders. He says "as we were going to seek unknown countries, we took all possible precautions, that if our enterprise was hazardous it should not be fool-hardy; for this reason we gathered all possible information from Indians, who had frequented those parts, and even from their accounts traced a map of all the new country, marking down the rivers on which we were to sail, the names of the nations and places through which we were to pass, the course of the great river, and what direction we should take when we got to it." *

It was on the 17th of May, 1673, that they started from the mission of St. Ignatius at Michilimakinak, and "made their paddles play merrily over Lake Huron and that of the Illinois (Lake Michigan) into the bay of the Fetid (Green Bay)." Here they met the Wild-Oat Indians, or, as they are called in French, the *Folles-Avoines*, a nation that dwelt upon the borders of the bay and the Menomonee River. Marquette informed them of his intended voyage, at which they were much surprised. They tried to dissuade him from the undertaking by telling him of hostile nations that dwelt upon the borders of the *Messi-Sepe*, whose scalping knives were never sheathed and who never spared strangers, but tomahawked them without any provocation; they told him of war-parties constantly in the field; that the Great River was very dangerous, unless the difficult parts were known; that it was full of frightful monsters who swallowed up men and canoes together; that there was a demon there who could be heard from afar, who stopped the passage and engulfed all who dared to approach; and finally, they told him of heat that was so excessive in those countries, that it would infallibly cause their death.

The zealous missionary thanked them for their good advice, and told them that he would only be too happy to lay down his life for the salvation of souls. They entered Fox River, of which Marquette says: "it is very beautiful at its mouth, and flows gently; it is full of bustards, duck, teal, and other birds attracted by the wild-oats,† of which they are very fond." On the 7th of June they arrived at a village of the Mascoutins, where they found three nations—the Miamis, the Maskoutens and Kikabous, living in

*Journal of Father Marquette.

† The *Zizania aquatica* Linn.

cabins made of rushes. Father Marquette was enraptured in beholding the position of their town, "the view was beautiful and very picturesque, for from the eminence on which it was perched, the eye discovered on every side prairies spreading away beyond its reach, interspersed with thickets or groves of lofty trees." After having assembled the Indians and addressing them upon the objects of their voyage, and after having received a present from the Indians, a mat which served them as a bed, they set out upon their voyage. They embarked in the "sight of a great crowd, who could not wonder enough to see seven Frenchmen alone in two canoes dare to undertake so strange and hazardous an expedition."

With the assistance of two Miami Indians, given them as guides, they found their way through the marshes to the "*portage*" where canoes and cargoes were carried and safely deposited in the Wisconsin. Here they bid good-by to the waters that flowed through the Great Lakes and the St. Lawrence by Quebec, and turned to follow those that were to lead them into strange lands. They bid their Indian guides good-by, and the *voyageurs* "were alone in an unknown country in the hands of Providence." They floated silently down the Wisconsin. "It was an unbroken solitude, where the ripple of their paddles sounded loudly on the ear, and their voices, subdued by the stillness, were sent back in lonely echoes from the shore."*

They "saw no small game or fish, but deer and elk in considerable numbers." Bancroft renders the word *vaches*, buffalo, but this is a mistake. They had not yet reached the buffalo ground. The words *vache sauvage*, as used by the Canadian French, applied to the American elk, *Cervus Canadensis*.†

At length, on the 17th day of June, with a joy that Marquette could find no words to express, they glided into the Great River, the storied theme of many an Indian tale. They gently followed its course to the forty-second degree of latitude. Here all was changed. Their birch-bark canoes were now floating between the great prairies of Iowa and Illinois, while the river was studded with beautiful islands fringed with willows whose branches were reflected back from the bosom of the water. Everything was strange and calculated to strike the imagination of the *voyageurs*. At one time a great fish struck one of the canoes so violently that

*McConnel; *Western Characters*, p. 88.

† *Discovery and Ex. of the Miss.*, J. G. Shea, p. 16.

they thought it would break the canoe in pieces; at another, they saw a monstrous animal swimming across the river.* And thus they floated on until they arrived at the home of the buffalo.

"Having descended as far south as 41° 28′," Marquette says, "we find that turkeys have taken the place of game, and *Pisikious*,† or wild cattle, that of other beasts. We call them wild cattle because they are like our domestic cattle; they are not longer but almost as big again, and more corpulent; our men having killed one, three of us had considerable trouble in moving it. The head is very large, the forehead flat and a foot and a half between the horns, which are exactly like those of our cattle, except that they are black and much larger. Under the neck there is a kind of large crop hanging down, and on the back a pretty high hump. The whole head, the neck and part of the shoulders are covered with a great mane like a horse's; it is a crest a foot long, which renders them hideous, and falling over their eyes, prevents their seeing before them. The rest of the body is covered with a coarse, curly hair like the wool of our sheep, but much stronger and thicker. It falls in summer and the skin is then as soft as velvet. At this time the Indians employ the skins to make beautiful robes, which they paint of various colors; the flesh and fat of the *Pisikious* are excellent and constitute the best dish in banquets. They are very fierce and not a year passes without their killing some Indian. When attacked, they take a man with their horns, if they can, lift him up, and then dashing him on the ground, trample on him and kill him. When you fire at them from a distance with gun or bow, you must throw yourself upon the ground as soon as you fire, and hide in the grass; for if they perceive the one who fired they rush on him and attack him.‡ As their feet are large and rather short, they do not generally go very fast, except when they are irritated. They are scattered over the prairies like herds of cattle. I have seen a band of four hundred of them."§

Thus far the exploring party had not seen a single human being; on the 25th of June, however, they saw a human track in the

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*The "great fish," it is supposed, was the Mississippi cat-fish, and the "monstrous animal" either the tiger-cat or the panther.

†Algonquin name for buffalo, called also, in Indian, *Beezhike*.

‡"When these animals are shot at a distance of fifty or sixty yards, they rarely, if ever, charge on the hunters." *Audubon and Bachman, Quadrupeds of North America*. Vol. 2, p. 44.

§Marquette's Journal, p. 19 of J. G. Shea's *Dis. and Ex. of The Miss.*

sand. Marquette and Joliet followed it. It led to a path, and that to an Indian village. Marquette hailed the Indians in the Illinois language, and they answered, "we are Illinois." They feasted the pale-faces upon sagamity,* fish, dog, and buffalo—the fat of the land. The master of ceremonies blew his breath upon the food to cool it, and, with spoons of buffalo horn, put three or four mouthfuls in the mouths of their guests, "as we would feed a bird." After five days of feasting, smoking and council, six hundred men, women and children escorted them to their boats, and, after promising to return to stay with them, they again committed themselves to the current of the *Messi-Sepe*. They passed by the *Piesa* paintings upon the face of a limestone cliff, of which Marquette gives a description, and while conversing about them, they heard the rushing of the waters of the Missouri, known to them by its Algonquin name of *Pekitanoui*, or Muddy River. Swollen by the melting of snows a thousand miles away in the mountains, it was pouring its impetuous current into that of the Mississippi, freighted with large trees, branches and drift wood, "real floating islands," says Marquette. He speaks of the mouth of the Ohio River, then known as the *Ouaboukigou*, which we have corrupted into *Wabash*, and applied to a tributary of the Ohio. The word Ohio is of Iroquois origin. The original was *Oheo* or *Youghio*, and meant *beautiful*. Farther down they met other Indians who feasted them on *wild-beef*. Marquette says of them "that they did not know what a beaver was, and their riches consisted in the skins of *wild-cattle*." He speaks of the Indians on the lower Mississippi as being armed with bucklers made of the skins of wild cattle, and says "that the number of wild cattle they heard bellowing made them believe that the prairies were near." The *voyageurs* returned about the last of August or the first of September, passing up the Illinois River. Upon its banks he again met the Peoria Indians, the same that were at Moingona. Of the country Father Marquette remarks, "we had seen nothing like this river for the fertility of the land, its prairies, woods, *wild-cattle*, stag, deer, wild-cats, bustards, swans, ducks, parrots, and even beaver; its many little lakes and rivers."†

Father Claude Allouez, in a "Narrative of a Journey to the Illinois," written shortly after Marquette's voyage, in speaking of the

* Indian meal boiled in water and seasoned with grease.

† Marquette's Journal, p. 19 of J. G. Shea's *Dis. and Ex. of the Miss.*

occupations of the Indians, says, "they hunt cattle, deer, turkeys, cats, a kind of tiger, and other animals, of which they reckon twenty-two kinds, and forty kinds of game and birds."*

The buffalo was of incalculable benefit to the Indians. Of the hoofs and horns they manufactured glue. The tallow was an article of commerce and was used for various purposes, among which was that of mixing with Indian meal to make *sagamity*. The tongue was considered a delicacy and the "jerked" beef served them for bread and meat. Of the skins the Indians made robes for beds or the floor of the cabin, or for blankets at night. Of the raw hide they cut thin strips for making snow shoes and various other purposes. The skins were used by the Sioux Indians for covering for their lodges and the modern Mandans stretch a raw buffalo hide over a wicker frame, and thus, using it as a substitute for birch bark, make a light, portable boat similar in construction to that of the coracle of the ancient Britons, or the Esquimaux *kaiak*.† They also made spoons and ladles of the horns, and, according to Marquette, the Illinois Indians used the bones for the same purpose. He says, "they made all their dishes of wood, and their spoons of the bones of the buffalo, which they cut so well that it serves them to eat their sagamity easily." The chiefs wore beautiful scarfs "ingeniously made of the hair of bears and wild oxen."

From Father Marest we learn that these scarfs were made by the women, also the mats for wigwams. In a letter dated Kaskaskia, November 9th, 1712, he says, "the chase and war are the sole occupations of the men, while the rest of the labor falls upon the women and girls. They are the persons who prepare the ground for sowing, do the cooking, pound the corn, build the wigwams, and carry them on their shoulders in their journeys. Their wigwams are constructed of mats made of platted reeds which they have the skill to sew together in such a way that the rain cannot penetrate them when they are new. Besides these things, they occupy themselves in manufacturing articles from buffalo's hair, and in making bands, belts and sacks, for the buffaloes here are very different from our cattle in Europe. Besides having a large hump on the back of the shoulders they are also entirely covered with a fine wool, which our Indians manufacture instead

*Ibid. p. 75.

†See Dr. Wilson's Prehistoric man. p. 115.

of that which they would procure from sheep, if they had them in the country." *

Father Rasles also describes the occupations of the women. "They toil like slaves from morning till night. It is their duty during summer to cultivate the earth and plant the Indian corn; and from the commencement of winter they are occupied in manufacturing mats, dressing skins, and many other works of the kind, for their first care is to provide everything that is necessary for their cabin." †

In the chase of the buffalo the Indian relied mainly upon his bow and arrow. The Indians of that period were very expert in their use. The little bow and the tiny arrow, pointed with the little flint arrow-heads found everywhere over our state, was placed in the hands of Indian boys who ranged among the hills, practising upon small birds, and "they became so skilful that at ten or twelve years of age they scarcely ever failed to kill the bird at which they aimed." ‡

Little boys of the Sioux nation, were thus early taught the use of the bow, and, also, "shot small sun-fish with a bow and an arrow, with a little spear fastened to it." § The Illinois were in the habit of shooting fish with the bow and arrow. "They embarked in a canoe with their bows and arrows; standing upright, for the purpose of more easily seeing the fish, as soon as they perceived it, they pierced it with an arrow." ‖ I have no doubt but that the Indian boys of Illinois also shot the sun-fish with the bow and arrow.

Father Marquette described the Illinois Indians as "well-formed, nimble, and very adroit in using the bow and arrow." Allouez bears testimony upon the same point, "they ordinarily carry only the war-club, bow, and quiver full of arrows, which they discharge so adroitly and quickly that men armed with guns have hardly time to raise them to their shoulders. They also carry a large buckler made of the skins of wild-cattle; which is arrow proof and covers the whole body." ¶

From Father Rasles, we learn the character of the arrows, and

* Kip. *Early Jesuit Missions*. p. 199.
† Ibid. 38.
‡ Ibid 26.
§ *History, Condition, Prospects* etc. Schoolcraft, Vol. 4. p.61.
‖ *Early Jesuit Missions*, Kip. p. 40.
¶ *Dis. and Ex. of Miss.* J. G. Shea, p. 75.

the skill with which they were used. "Arrows are the principal arms which they (Illinois Indians) use in war and in the chase. They are pointed at the end with a stone cut and sharpened in the shape of a serpent's tongue; and if no knife is at hand, they use them also to skin the animals they have killed. They are so skilful in using the bow, they scarcely ever fail in their aim, and they do it with so much quickness that they can discharge a hundred arrows in the time another person would use in loading a gun."*

The Indians on the lower Mississippi shot an arrow clear through the horse of De Soto, and it is said that the modern Indians on the plains, think it no unusual feat to send an arrow through a buffalo, so that it falls on the ground upon the other side, and this was doubtless done often by the Indians of the olden time upon our prairies.

Some of the descriptions given by the Jesuits of our vast prairies, with herds of buffalo and other animals grazing upon them, are charming indeed. Father Rasles in his letter above quoted, speaks of vast herds of buffaloes and roebucks, and says, "that not a single year passes but they kill more than a thousand roebucks and more than two thousand buffaloes. From four to five thousand of the latter can often be seen at one view grazing on the prairies."†

"Of all the nations of Canada, there are none who live in so great abundance of everything as the Illinois. Their rivers are covered with swans, bustards, ducks and teals. One can scarcely travel a league without finding a prodigious multitude of turkeys, who keep together in flocks, often to the number of two hundred."‡

Father Hennepin also speaks of herds of buffalo, grazing between

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* *Early Jesuit Missions* Kip. p. 39.

"†Lewis and Clark in descending the Missouri in 1806, on passing the environs upon White River, estimated that they saw twenty thousand on the prairies at one time." Schoolcraft. *Hist. Cond. Prospects, etc.*, Vol. 4. p. 93.

"Some idea of the immense numbers of bisons to be seen on the wild prairies, may be formed from the following account, given to us by Mr. Kipp, one of the principals of the American Fur Company, who, while he was travelling from Travers' Bay to the Mandan nation in the month of August in a cart heavily laden, passed through herds of buffalo for six days in succession. At another time he saw the great prairie near Fort Clark on the Missouri River, almost blackened by these animals, which covered the plain to the hills that bounded the view in all directions, and probably extended farther." *Quadrupeds of North America*, Audubon and Bachman. Vol. 2. p. 47.

These quotations are made to justify the statements as to the vast numbers of buffaloes that formerly roamed over the prairies of Illinois.

‡ Kip. *Early Jesuit Missions*, p. 39.

the bluffs and the banks of the Mississippi, or as he called it, in his journal, the river Colbert. The voyage of Hennepin down the Illinois and up the Mississippi River, was in the year 1680.* Of the scenery upon the Illinois River, called by him, the *Seignelay*, he says "it is lined with hills, whose sides are covered with fine large trees. Some of these hills are half a league apart, leaving between them a marshy strip often inundated, especially in the spring and fall, but producing, nevertheless, quite large trees. On ascending these hills, you discover prairies further than the eye can reach, studded at intervals with groves of tall trees, apparently planted there intentionally."

Father Membre, in his narrative of the voyage of La Salle (1682) gives a glowing and poetical account of the beauty of the country He speaks of the Illinois River as "edged with hills, covered with beautiful trees of all kinds, whence you discern vast prairies on which herds of wild-cattle pasture in confusion." . . .

"The fields are full of all kinds of game, wild-cattle, stags, does, deer, bears, turkeys, partridges, parrots, quails, woodcock, wild-pigeons and ring-doves. There are also beavers, otters, martens, till a hundred leagues below the Maroa,† especially in the river of the Missouri, the *Ouabache* (Ohio) that of the Chepousseau (the Cumberland?) which is opposite it, and on all the smaller ones in this part." . . . . . .

"The cattle of this country surpass ours in size; their head is monstrous, and their look frightful, on account of the long, black hair with which it is surmounted, and which hangs below the chin, and along the houghs of the animal. It has on the back a kind of crest, of which that nearest the neck is longest, the others diminish gradually to the middle of the back. The hair is fine and scarce inferior to wool. The Indians wear their skins, which they dress very neatly with earth, which serves them for paint. These animals are easily approached; they could be easily domesticated."‡

Charlevoix, who passed through the Mississippi Valley in 1721, gives a fine and detailed description of the buffalo, as seen by him on the prairies, and the Indian method of hunting it. As his work is very scarce I transcribe the whole of his remarks upon the buffalo.

* *Dis. and Ex. of the Miss.* J. G. Shea, p. 108. 109.

† The Tamaroas, a tribe of Indians located just east of the mouth of the Illinois River.

‡ *Dis. and Ex. of the Miss.* J. G. Shea, p. 179. 180.

"In the southern and western parts of New France,* on both sides of the Mississippi, the most famous hunt is that of the buffalo, which is performed in this manner: the hunters range themselves in four lines, which form a great square, and begin by setting fire to the grass and herbs, which are dry and very high; then as the fire gets forwards they advance, closing their lines. The buffaloes which are extremely afraid of fire, keep flying from it, and at last find themselves so crowded together, that they are generally every one killed. They say that a party seldom returns from hunting without killing fifteen hundred or two thousand. But lest the different companies should hinder each other, they all agree before they set out about the place where they intend to hunt. There are also some penalties appointed against those who transgress, this rule, as well as against those who, quitting their posts, give way to the beasts to escape. These penalties consist in giving a right to every person to strip those who are guilty, and to take away even their arms, which is the greatest affront that can be given to a savage; and to pull down their cabins. The chiefs are subject to this penalty as well as the others, and if any were to endeavor to exempt them from this law, it would raise a civil war amongst them, which would not end soon."

"The bull, or buffalo, of *Canada* is bigger than ours; his horns are low, black and short, he has a great beard of hair under his muzzle, and a great tuft of hair upon his head, which falls down over his eyes and gives him a hideous look. He has a great bump on his back, which begins at his hips, and goes on increasing up to his shoulders; and this bump is covered with hair, something reddish, and very long; the rest of his body is covered with black wool, which is much valued. They say that the skin of the buffalo has eight pounds of wool on it. This animal has a large chest, the hind parts small, the tail very short, and one can scarce see any neck it has, but its head is bigger than that of the European bull. He runs away generally at the sight of any person, and one dog is enough to make a whole herd take to full gallop. The buffalo has a good smell, and to approach him without being perceived near enough to shoot him, you must go against the wind. When he is wounded he is furious and turns upon the hunters. He is as

* The whole of Canada together with the country on both sides of the Mississippi, from its source to the gulf, was then claimed by the French, under the name of New France.

furious when the cows have newly calved. His flesh is good, but they seldom eat any but that of the cows, because the buffaloes are too tough. As for his skin, there are none better: it is easily dressed, and though very strong, it becomes supple, like the best Chamois. The savages make shields of it, which are very light, and which a musket ball will not easily pierce." *

On the 6th day of October, 1721, as Charlevoix and his party were descending the Illinois River, he says he saw a great number of buffaloes crossing it in a great hurry, and he scarce doubted but that they were hunted by the Indians. On the next day he passed the mouth of the "*Saquimont*,† a great river that comes from the south; five or six leagues lower down he left on the same hand another, smaller, called the river *Macopines*.‡ These are great roots, which eaten raw are poison, but being roasted by a small fire for five or six days or more, have no longer any hurtful quality."§

In the year 1711, Father Marest made a journey on foot, with three Indian guides, from Cahokia on the east side of the Mississippi, south of the present city of St. Louis, to Peoria, on Lake *Pimetoui*, — this word, in Algonquin Indian, means land of fat beasts. He left the site of the present city of Springfield to his right about six miles, I should judge. He says, "journeys which are made in this country should not be compared with those in Europe. There you find from time to time villages and towns, and houses in which you can rest, bridges or boats to cross the rivers, beaten paths which lead to your destination, and persons who can place you in the right way, if you have strayed. Here there is nothing of the kind, and we travelled for twelve days without meeting a single soul. At one time we found ourselves upon prairies which were boundless to our view, cut up by brooks and rivers, but without discovering any path which could guide us, and then again it became necessary to open a passage through dense forests, in the midst of brushwood covered with thorns and briars, and at other times we had to cross marshes filled with mire, in which we sometimes sank to the waist." . . . . "Besides these inconveniences, common to all those who travel through these de-

* Charlevoix, *Travels in North America*, Vol. 1, p. 92.
† Sangamon.
‡ Macoupin.
§ Charlevoix, Vol. 2, p. 162.

serted lands, we had the addition also of hunger during the whole of our journey. It was not because we did not see great numbers of stags and deer and particularly of buffaloes, but our Indians were not able to kill any. A rumor they had heard the day before our departure, that the country was infested by parties of the enemy (probably the Sioux), prevented them from carrying their guns, for fear of being discovered by the report when they fired, or of being embarrassed, if it should be necessary for them to seek safety in flight. Thus, they could use nothing but their arrows, and the buffaloes which they hit, fled, carrying with them the arrows by which they had been pierced, and went to die in some distant place." . . . . . "It was not without reason that they feared meeting with any war party of the enemy, for they would have received no quarter from them. Either their heads would have been cut off, or at best they would have been made prisoners, to be burnt at last before a slow fire, or to be used for food in their feasts." *

From the same letter, written at Kaskaskia in 1712, we learn that it was then the constant habit of the missionaries to accompany the Indians in their hunts. There were during the year two great hunts; that of the summer, which scarcely lasted three weeks, and that which took place during the winter, which lasted four or five months. With but a slight exertion of the imagination one can see the motley group of Indians, French and half-breeds, headed by the Blackgown,† issuing from the old Kaskaskia of 1712, where the wigwams of the savage and the rude huts of the French indicated the contact of civilization and barbarism, and turning their faces to the north toward the great prairies where they were to engage in the chase of the deer, the elk and the buffalo.

These old missionaries soon learned to love the rivers and prairies of Illinois and, if duty called them to Canada or the Great Lakes, to rejoice upon their return to the Illinois missions. Father Marest remained a short time with the *Peorias* and then continued his journey on to Michilimakinak. After stopping there a few days he started to return in the bark canoe by the way of the Lakes and the St. Joseph River, called now Miami River. He

* *Early Jesuit Missions*, Kip, p. 216, *et seq.*

† Everywhere among the western Indians the Jesuits were known by the name of Blackgowns.

says he "ascended the River St. Joseph to the '*portage*.'" Here they transported all there was in the canoe to the source of the Illinois River called *Haukiki*, which was a corruption of the Indian word *Theakiki*. They then carried over the canoe, launched it and continued their route. They were two days in making this portage, and then followed the windings of the *Theakiki* to the prairies of Illinois, where the old missionary joyfully exclaims, "at last we perceived our own agreeable country, the wild buffaloes and herds of stags, wandering on the borders of the river; and those who were in the canoe took some of them from time to time, which served for our food."*

The buffalo was first seen by Cortez and his followers, in 1521, a single individual being observed in a kind of menagerie or zoological collection of Montezuma, in Mexico. To this place the animal had been brought from the north by Indians, to whom the collection of rare birds and quadrupeds had been committed by the native monarch. It was not, however, till the expedition of Coronado north of the Gila, in 1540, that its natural ranges were penetrated. It was not found at all in the highlands of New Mexico. The Spanish adventurers had passed the Rio del Norte, and entered the region of the great southern fork of the Arkansas, before they encountered the immense herds which they describe. So headlong was the course of the droves of these animals following each other, that they sometimes pitched into and filled up entire gulfs and defiles lying in their track.† The buffalo was found by De Soto (1541) after he had crossed the Mississippi and entered the present area of Arkansas and Missouri.

Audubon and Bachman mention the buffalo as once existing upon the Atlantic coast, and further add that "authors state that at the time of the first settlement of Canada it was not known in that country, and Sagard Theodat mentions having heard that bulls existed in the far west, but he saw none himself." Lawson, in his "Journal of one thousand miles' Travel among the Indians, with a Description of North Carolina" (London, 1700) speaks of two buffaloes that were killed in that State on Cape Fear River. Audubon says that the bison formerly existed in South Carolina

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* *Early Jesuit Missions*, Kip., p. 224.

† Discovery and Ex. of the Mississippi. J. G. Shea, p. 18; History, Cond., Prospects etc., Vol. 4, p. 93. Schoolcraft cites Castenada's Narrative of an Expedition to Cibola, etc., p. 34, Mss.

on the sea board, and that he was informed that, from the last herd seen in that State, two were killed in the vicinity of Columbia. "It thus appears that at one period this animal ranged over nearly the whole of North America."* Names of places still retained, in many instances, indicate the former range of the buffalo. A river upon the Upper Mississippi was called by the Indians *Beezhike Sepe*, or Buffalo River, "on account," Father Hennepin says, "of the number of buffaloes found there." Charlevoix speaks of a river near Niagara Falls, which bore the name of *La Riviere aux Bœufs*, or Buffalo River, which was, no doubt, a French translation of the Indian name. Schoolcraft says that the city of Buffalo perpetuates the tradition of the former existence of the buffalo near Lake Erie. From Charlevoix we learn that, at the time he passed through Lake Erie (1721), the buffalo was still found in its vicinity. Writing from *The Strait* (Detroit), he says, "at the end of five or six leagues, inclining towards the Lake Erie, one sees vast meadows which extend above a hundred leagues every way, and which feed a prodigious number of those cattle which I have already mentioned several times."†

The view that the name *La Riviere aux Bœufs*, and that of the city of Buffalo, perpetuate the traditionary existence of the buffalo at the east end of Lake Erie, is corroborated by the fact, shown by Dr. Elliott Coues in the November number of the NATURALIST, that the buffalo formerly existed on the Kenawha River in Virginia.

Schoolcraft says, "It was found in early days to have crossed the Mississippi above the latitude of the mouth of the Ohio; and at certain times throughout the present area of Kentucky. It not only ranged over the prairies of Illinois and Wisconsin, but spread to Southern Michigan, and the western skirts of Ohio. Tradition says that it was sometimes seen on the borders of Lake Erie. It was also common to the southern parts of Wisconsin, and crossed the Mississippi into Minnesota above St. Anthony's Falls for the last time, it is believed, in 1820;"‡ and Audubon states, "in the days of our boyhood and youth, buffaloes roamed over the small prairies of Illinois, and herds of them stalked through the open woods of Kentucky and Tennessee; but they

* *The Quadrupeds of North America.* Vol. 2, p. 55.
† Charlevoix, *Travels in North America.* Vol. 2, p. 13.
‡ *History, Cond., Prospects, etc.*, Vol. 4, p. 92.

had dwindled down to a few stragglers, which resorted chiefly to the 'Barrens,' towards the years 1808 and 1809, and soon after entirely disappeared."*

From my own reading and reflection upon the subject, I would place the range of the buffalo, before the advent of the whites in this country, within the following area,—beginning upon the Atlantic sea-board at Charleston, thence north of west to the Mississippi, thence down the river to the gulf, thence to the mouth of the Rio Grande, thence up said river to the Rocky Mountains, thence north to the Great Slave Lake in latitude 60°, thence south-east to the source of the Mississippi, thence to the south end of Lake Michigan, thence east to the east end of Lake Erie, thence south-east to the Atlantic coast, near the mouth of Chesapeake Bay, and thence down the coast to place of beginning. I can at least show good authority for the buffalo having been found at all of the extreme limits of the above area, but of course we can only conjecture as to whether it ranged over the whole of the above territory at the first settlement of this country.

But the buffalo has been driven westward until now the area over which it ranges is probably not over one-tenth of that above described. Like the Red Indian it must succumb in that mighty struggle which has been going on from the remotest geological time,— which has literally filled the earth with relics of lost species and still continues to-day, controlled by the same laws, and producing the same effects as it did when the last mastodon laid down to die.

The old French and Indian population, before the year 1812, exterminated the buffalo from the prairies of Illinois, notwithstanding the countless numbers that roamed over them at the end of the seventeenth century and during the first half of the eighteenth. It has not been more than one hundred and twenty or or one hundred and fifty years at farthest, since they were being slaughtered by the thousand everywhere over our state, yet, though for years I have kept a sharp lookout, I have never met with a single bone of this animal.† Audubon states that in the

* *Quadrupeds of North America*, Audubon and Bachman, Vol. 2, p. 36.

† Prof. Worthen informs me that he has found the bones of the buffalo very rare in this state. A portion of a skeleton comprising big bones, ribs, etc. was found with the Niantic mastodon, four feet below the surface; and Mr. Broadhead found a skull only a foot or two below the surface in Christian or Montgomery county, and those are all the remains he knows of having been found recently in the state.

Far West "the prairies are in some places whitened with the skulls of the buffalo, dried and bleached by the summer's sun and the frosts and snows of those severe latitudes in winter."* No doubt their skulls and other bones were as plenty upon the prairies of Illinois a hundred years ago. It seems to be the object of nature as soon as possible after life is extinct to destroy the remains of every organized creature, and to throw back its component parts into the rounds of circulation again, and it is only a very rare accident that even the hardest parts, such as hoofs, horns, teeth, etc., are fossilized. I presume that not one in every fifty thousand, of the buffaloes that were in Illinois during the eighteenth century, will stand a chance to attest its former existence by a single bone at the beginning of the twentieth century. Large numbers of the Elk, *Cervus Canadensis*, grazed upon the prairies of Illinois, as will be seen by the above extracts, and Audubon says, that a few were still to be found in Kentucky, and across the Ohio River in Illinois, at the time he settled in that state. Their horns, which from their size and hardness, were better calculated to resist the effects of time than the buffalo, are sometimes, but rarely, found in our state. Two of them were picked up this year, in Scott County, within ten miles of the Illinois River.

"Instead of its being part of the plan of nature to store up enduring records of a large number of the individual plants and animals which have lived on the surface, it seems to be her chief care to provide the means of disencumbering the habitable areas lying above and below the water, of those myriads of the solid skeletons of animals, and those massive trunks of trees, which would otherwise soon choke up every river and fill every valley. To prevent this inconvenience she employs the heat of the sun and moisture of the atmosphere, the dissolving power of carbonic and other acids, the grinding teeth and gastric juices of quadrupeds, birds, reptiles, and fish and the agency of many of the invertebrata."† No better illustration of these words of Sir Charles Lyell can be found, than that of the scarcity of the bones of the buffalo and other large mammals that once formed a part of the fauna of the great prairies of the Upper Mississippi.

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* *Ibid*, Vol. ii, p. 43.

† *Antiquity of man*, p. 146.

NOTE:—Teeth of the Bison have been found in the Quaternary clays of Gardiner, Me. See NATURALIST, Vol. i, p. 268, note.—EDS.

REVIEWS AND BOOK NOTICES.

THE FOSSIL PLANTS OF CANADA.* — This elaborate work relates chiefly to the Devonian flora of Gaspé and St. John, New Brunswick, and indeed is a revision of the Pre-carboniferous flora of Eastern North America, as the author has introduced "such allied species from New York, Ohio, and Maine as may serve to illustrate the Canadian species." He proposes the term Erian, derived from the great Erie division of the New York geologists, instead of Devonian, hoping "to keep before the minds of geologists the caution that they should not measure the Erian formations of America or the fossils which they contain, by the comparatively depauperated representatives of this portion of the geological scale in the Devonian of Western Europe."

The notices and figures illustrating the Dadoxylon, "evidently an Araucarian conifer" of which no foliage nor fruit have been found, only drifted trunks a foot in diameter; of the Psilophyton, the species of which were "synthetic or generalized plants," having rootlets resembling those of some ferns, stems having the structure of Lycopodium, and rudimentary leaves also resembling those of the club mosses (Lycopodiaceæ), branchlets with circinati venation like that of ferns, and sporangia of a type quite peculiar to themselves, are of much interest. He also describes and figures the trunks of tree ferns from Gilboa, N. Y. "where these trunks are stated to occur in an erect position in sandstone" and are now in Prof. Hall's collection, while Prof. Newberry has communicated to him "two well characterized trunks of tree ferns from the Devonian of Ohio, and another from Gilboa, N. Y. so that the occurrence of large tree ferns in the Erian flora is now well established."

As to Silurian vegetation, a few sea weeds occur in the Upper Silurian limestones of Gaspé, but with them are associated in the lower part of the limestone, remains of the land plant Psilophyton, which suffice to indicate the existence of neighboring land, probably composed of the Lower Silurian rocks, and supporting vegetation. He also announces on a subsequent page his discovery of fossil trees of the type of Prototaxites in the Upper Silurian of England.

*The fossil plants of the Devonian and Upper Silurian formations of Canada. By J. W. Dawson, LL. D, F.R.S, F.G.S. With twenty plates and cuts. Geological Survey of Canada, Montreal. Dawson Brothers, 1871. Royal 8vo. pp. 923. $2.50.

Comparing the Devonian flora with that of the Carboniferous period, so familiar to most of our readers, who have seen the beautiful impression of fern leaves from the shales enclosing veins of coal, our author states that *generically* the two floras are in the main identical. "The most important and characteristic Carboniferous genera are also among those best represented in the older flora. On the other hand, while some Carboniferous genera have not yet been recognized in the Devonian, the latter possesses some peculiar generic forms of its own, and these are especially abundant in the lower part of the system. As examples of such genera I may name Psilophyton, Prototaxites, Leptophleum and Arthrostigma. Further, it may be remarked that these peculiar Erian plants present highly composite or synthetic types of structure, giving to these a more archaic air than that of the Carboniferous flora." "Specifically, however, the Devonian flora is almost altogether distinct from the Carboniferous. Even the same genera are represented by distinct species, and it is possible that some of the few species which we now identify with those of the Coal, will in future be found to be distinct." He remarks that "while the distribution of genera in the Devonian leads us to infer climatal conditions in the main resembling those of the Carboniferous, it would also lead us to conclude that the local diversities were greater, and that there was less of that dead level of similar local conditions which prevailed so extensively in the Carboniferous period. The Devonian plants probably grew on limited rocky islands, bordered by much less extensive and permanent lowlands than those of the Carboniferous era."

Although we have quoted enough to convince our readers that we are indebted to Dr. Dawson for one of the most valuable and entertaining monographs that has enriched our science during the year, we have yet to glean still more interesting results of his patient and extended researches in fossil botany. Questions regarding the origin of the flora as a whole, as well as of the single species, and the death of both isolated species and entire floras, inevitably arise and must be met by the student in science. They are discussed by our author in his usual candid and philosophical spirit. He refers—

"For a moment to views of the sequence of Palæozoic plants which might be entertained in accordance with theories of derivation of species now prevalent. The lower Devonian is dis-

tinguished by the abundance of some remarkable forms referred to algæ of the genera Spirophyton and Dictyophyton of Hall, also for the occurrence of vast quantities of humbly organized acrogens suited for a semi-aquatic habitat, as Psilophyton and Annularia. May not these two groups of plants be related in the way of derivation? Again the synthetic types of acrogens of the lower Devonian, and the prototypal exogens of the genus Prototaxites give way in the middle Devonian to more perfect and specialized types of acrogens and gymnosperms; may they not have been advanced by a process of evolution? Such speculations have charms for persons of vivid imagination, and may be supported by the analogy between the progress of the development of the individual plant and the succession of plants in geological time; but the present case affords to them a support more apparent than real. The gap between the algæ and acrogens like Psilophyton with a well developed scalariform axis is very great. The algæ in question did not precede Psilophyton but were contemporaneous with it, and their association may be explained by the co-existence of submerged shallows favorable to algæ, and swampy flats favorable to Psilophyton and its allies, and by the alternation of these conditions in the same locality. Prototaxites does not change into Dadoxylon. It disappears and is replaced by a type of wood which continues to the present day. Psilophyton continues to exist without improvement along with the Lepidodendra and ferns of the Middle and Upper Devonian, and merely becomes less abundant until it finally disappears. The phenomena are rather those of the gradual extinction of the old flora and the introduction of a new one from some different source. If therefore we desire to account for the succession of floras in this way, we must suppose local extinction and the introduction from another region of plants which in the meantime have been modified there."

In considering the relations of the Pre-carboniferous to the older floras, he considers that in accordance with the views that have been so well illustrated by Prof. Hall as to the derivation of the sediments forming the American Silurian strata from the northeast, and the gradual extension in each succeeding period of land and shallow water to the southwest we should expect to find the oldest land plants towards the northeast. "Accordingly, it is in Gaspé that as yet we have the only link of connection of the Erian flora with that of the Silurian period," *i. e.*, the remains of a club moss (Psilophyton); and he believes that a by no means sparse land vegetation accompanied it. But he boldly inquires whether land plants did not exist in the Lower Silurian, and even hints that we might look for the actual origin of land vegetation in the

Laurentian period. He thinks it "possible that the rocks of Newfoundland or Labrador, or beds now buried under the Atlantic, may be those which alone contain the remains of the lower Silurian plants." The Eophyton of Torell from the primordial or Lower Silurian rocks of Sweden, "if a land plant at all" (for Dawson regards "it as a doubtful plant, similar forms being apparently produced by impressions of feet or fins on the surface of mud"), the author regards as more nearly allied to Psilophyton than to any other genus, saying that "whatever the nature of these forms, they are present in the primordial of America as well. Mr. Murray has found them in Newfoundland and Mr. Selwyn in Nova Scotia, in rocks probably of this age."

"Such views as to a primitive Silurian and Laurentian flora are strengthened by the obvious fact that the plants of the lower and middle Devonian have the aspect of the remains of a decaying flora verging on extinction, and pointing backward in geological time, while those of the upper Devonian give us a great number of new forms and point onward to the Carboniferous. As already stated, the lower and middle Erian flora stands by itself in the prevalence of such archaic, and prototypal forms as Prototaxites, Psilophyton, Nematoxylon and Arthrostigma. Is it probable that it was thus isolated? Is it not more likely that these plants were the successors of an older and more primitive flora?

This is vividly presented to the mind in the Erian conifers. In the lower sandstones of Gaspé we find numerous trunks of large trees, all having the structure of Prototaxites. In the Hamilton Group of New York and in the sandstones of St. John, these are replaced by Dadoxylon, a type extending into the Carboniferous and thence to the modern Araucarian pines. There is no transition from one type to the other, nor are they intermixed in the same beds. The Middle Devonian would thus seem to have been the grave of Prototaxites, and the birth-place of Dadoxylon, in so far as the regions in question are concerned.

Something of the same kind occurs in the Carboniferous, in the scanty and somewhat antique Lower Carboniferous flora pointing backward to the Upper Devonian, just as the Lower Devonian may be supposed to point backward to the Silurian. The above reasons lead me to anticipate with confidence the discovery in the Silurian of a flora similar in type to that of the Lower Devonian, but probably richer in species.

Is it possible to indicate where such earlier flora may be expected? In Eastern America, from the Carboniferous period onward, the centre of plant distribution has been the Appalachian chain. From this the plants and sediments extended westward in times of elevation, and to this they receded in times of depression.

But this centre was non-existent before the Devonian period, and the centre for this must have been to the north-east whence the great mass of older Appalachian sediment was derived. In the Carboniferous period there was also an eastward distribution from the Appalachian, and links of connection in the Atlantic bed between the floras of Europe and America. In the Devonian such connection can have been only far to the northeast. It is therefore in Newfoundland, Labrador and Greenland that we are to look for the oldest American flora, and in like manner on the border of the old Scandinavian nucleus for that of Europe. Again, it must have been the wide extension of the sea of the Corniferous limestone that gave the last blow to the remaining flora of the Lower Devonian; and the re-elevation in the middle of that epoch brought in the Appalachian ridges as a new centre, and established a connection with Europe which introduced the Upper Devonian and Carboniferous floras. Lastly, from the comparative richness of the later Erian flora in Eastern America, especially in the St. John beds, it might be a fair inference that the northeastern end of the Appalachian ridge was the original birth-place or centre of creation of what we may call the later Palæozoic flora, or of a large part of that flora."

Finally, in a supplementary section Dr. Dawson gives us his theoretical views as to the origin and extinction of species. "Some of the forms reckoned as specific in the Devonian and Carboniferous may be really derivative races." These may have originated in one or more of the following ways:—(1) By a natural tendency in synthetic types to become specialized in the direction of one or other of their constituted elements. (2) "By embryonic retardation or acceleration in the manner illustrated by Hyatt and Cope." (3) "The contracting and breaking up of floras." (4) "The elevation of a great expanse of new land at the close of the Middle Erian and the beginning of the Coal period, would by permitting the extension of species over wide areas and fertile soils, and by removing the pressure previously existing, be eminently favorable to the production of new, and especially of improved varieties."

Anthropological Institute of New York.*—In a former number we called attention to the organization of this society, of which we have now received the first fruits in the form of a very interesting and important number of its Journal. The publications

*Journal of the Anthropological Institute of New York. Vol. i, No. 1. 8vo pamph. pp. 100. New York. 1871–72. [50 cts.]

of the Institute will consist of Memoirs, which will contain papers more exhaustive in their character than those published in the Journal, which is to contain abstracts of the records of the meetings, the shorter papers and such translations and miscellaneous matter as the committee think worth printing.

The character of the new society promises to be such that only pure anthropological science will be allowed entrance to its meetings, and the list of present officers indicates that its objects will be fulfilled. One of the duties of the president of the society is to give a review of the progress of Anthropological Science during the year, and with Mr. Squier in the chair we look forward to an important contribution as the first annual address.

The present number contains the proceedings consequent to the organization of the Institute, with its Constitution, By-laws etc., and several papers.*

Taken all together we do not know when we have sat down to a pamphlet and read every page with greater interest and satisfaction derived from the knowledge attained, than we experienced while reading the first number of this Journal. We shall make extended quotations in future numbers of the NATURALIST.

BOTANY.

ON UTILITY IN THE SUPERABUNDANCE OF SEEDS AND POLLEN.—In the vicinity of Pike's Peak last summer I noted that *Pinus edulis*, in many instances, had its usually two "leaves" united into one. As winter approaches the terete branchlet, as I call these "needles," divides and exposes the two inner faces. Thus the one year branchlet is terete; when two or more years old the "leaves" are in twos or threes. The trees in this monophyllous condition grow as well, and as far as can be seen, are in as favorable circumstances to engage in the struggle for life as any Pine

*The Progress of Anthropology in Europe and America: a translation, by W. L. Roberts, of Dr. Broca's address before the Anthropological Society of Paris. A review of Von Martius' paper on some points of South American Ethnology, by Charles Rau. Antiquities from the Guano or Huana Islands of Peru, with illustrations, by E. G. Squier. Sculptured Rocks, Belmont Co., Ohio, with illustrations, by W. Ward. Canoe in Savannah River Swamp, with cut, by C. C. Jones, jr. Notes on Trepanning among the Incas, by M. Broca, Dr. Nott, Dr. Draper and Mr. Squier. Followed by miscellaneous matter from various sources, containing Mr. Squier's remarks on the "Arch in America," a letter from Father Mengarini on the Indians of Oregon. Notes and anthropological items from all countries.

can be, whether with one, two, or five leaves, and this too though the inner or, as we would say of true leaves, the upper surfaces, so essential to most plants, do not exist during the growing time.

In my recent paper on Cotyledons ("Proceedings American Association," Indianapolis) I noted that the usually pluri-cotyledonous *Abies excelsa* frequently has but three, and at times but two seed lobes. The number of lobes does not seem in the slightest degree to aid the individual or to exert any influence whatever on the preservation of species.

The trees and shrubs of Europe mostly bear seeds more profusely than closely allied American species. *Quercus robur*, commences to bear acorns when ten years old. It then bears annually. *Quercus alba*, the American white, rarely fruits till fifteen or twenty, and then seldom leaves but every other year, although generally more prolific than any other North Eastern American oak. It never approaches in profusion the best specimens of the English species.

Liriodendron tulipifera appears to have an abundance of pollen, so far as an examination of its numerous flowers indicates. The seeds are distributed by a light wing. The immense majority of the distributed carpels are seedless.

In the Pine family the pollen is in immense profusion. If we climb into a tree just as the pollen sacs are bursting, our clothes are as yellow as if turned out of a mustard bag.

Many observations of a similar character must have been made by every botanist.

At page 183 of this journal, 1871, I said we may say of pollen or of seeds themselves, that "nature makes numberless things for which she has no use whatever. Perhaps it may be, that like the human mind, the mind of nature likes variety and profusion, in the effort for which mere utility is not always consulted." The editors remark—"and of this sort pollen and seeds are queer examples. Does he mean that these are useless because superabundant enough to ensure against risk and loss, and appropriation by animals through which fertilization and dispersion are subserved?"

It does seem to me that no utility is subserved by the division of Pine leaves or of cotyledons; nor in a large number of cases which might be cited as to the mere form of plant structure. In the case of the oak, and other similar instances the American species holds its own against all losses as well as its English brother;

and doubtless would if it only fruited every ten years instead of every two, and especially when we see the Liriodendron with most of its seeds infertile and yet very widely distributed, must we not regard the profusion of English seed useless?

And in regard to the pine pollen, certainly after granting the widest margin for "insurance against all losses," the vast proportion is useless so far as any benefit to the individual or species is directly concerned.* If we regard pine pollen as produced by nature for the purpose not of fertilization merely, but for the purpose of forming coal also (see Huxley on coal), it would suit a popular idea of utility in nature. But the coal formed out of deposits of pollen from Sigillarias and Lepidodendrons, serves no purpose to these plants.

It was in this sense that I meant the over production useless; and in this sense I suppose I should differ from much in modern philosophy, which, as I understand it, seeks in *every production* of life a benefit to the parent which produced it. Yet in one sense the production may not be regarded as useless. A boy whittles

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*In reaffirming our bit of criticism which Mr. Meehan fails to see the point of, it is best to keep the point clear from all heterogeneous matters (such as the nature of pine-leaves and of cotyledons, in respect to which Mr. Meehan's views are very peculiar), and stick to the case of the abundance of pine-pollen, vast in itself and in proportion to the seeds to be fertilized. This excess of pollen Mr. Meehan adduces in proof of the proposition "that Nature makes numberless things for which she has no use whatever." But—to continue the personification—before he condemns Dame Nature for wasteful profusion, let him consider, as she had to do, the conditions of the particular case in hand; viz., a species of tree with flowers of separate sexes, destitute of honey or other enticement for insects, and therefore to be fertilized by the wafting of pollen by the wind, and in view the advantage of wide breeding. Can he be quite sure that there is a wasteful excess of pollen here; and does he not see that, at least, this is not a convincing argument "that nature makes numberless things for which she has no use whatever?"

Now, while we plead "extenuating circumstances" in behalf of Dame Nature in this particular case, it may be allowable to bring testimony to her general good character for economy where no purpose is to be served by profusion. Take the case of those surely fertile little blossoms of Impatiens (referred to on page 109 of this number), or the similar flowers of violets, Specularia, and the like, where nature means close fertilization, and therefore shuts up anthers and stigma together, and endows the pollen grains with the power to send out their tubes from the one to the other—so dispensing with wind, insects, or other carriers—here a superabundance of pollen might imply waste. But in these cases—and in these only—the grains of pollen do not very much exceed the number of ovules to be fertilized!

Apropos to the paucity of seeds which mature in Liriodendron, and that some oaks are much more prolific than others, but the least fertile showing no disadvantage therefrom in the struggle for life, we were disposed to explain how small a factor, comparatively, the mere number of progeny must be in the problem of natural selection. But that is best done by referring to Darwin's "Origin of Species," chapter third, especially to the paragraph in which he states that the Fulmar petrel lays but one egg, yet it is believed to be the most numerous bird in the world."—EDITORS.

a stick, the shavings are of no benefit to him. But the activity which produced the shavings is a power in boy life, other things he does which aid both in the purpose and in the results. He gathers apples. The action serves him, and the result is food for action in the future.

To illustrate this again in plant life. We all know how much time has been given to studying the uses of thorns. What is the use of thorns to a rose. The sweet briar has a few scattered recurved thorns. But when a certain insect deposits an egg in a growing branch, the gall and a portion of stem above and below, become densely crowded with straight sharp thorns. I take it that these thorns are entirely useless to the plant, and yet the vital action which produced them no doubt served a useful purpose; and I should say the same of all the thorns on the whole plant. I suppose some might say that this echinate gall was the result of abnormal vital action, and is perhaps to be credited to the insect which was thus better protected from enemies. But how this larva is better protected by these pines I fail to see. The principle applied to the boy with the shavings seems more philosophical. The thorns are useless, but the action which produced them was not.

I have been content in the past with recording my observations, only occasionally hazarding a suggestion as to the direction in which they pointed. I feel that my field and my opportunities are too limited to allow me to put full faith in my own judgment when opposed to the views of those much better situated to decide. If in this I offer more than my usual quota of opinion, it is out of respect to the editor's inquiry. — Thomas Meehan.

Plant Dryers. — The best article I have ever used,—better than any blotting paper — is one of the kinds of sheathing paper made by Messrs. Roberts and Son, of Waltham. In any large quantity it can be had cut to size at the mill. I have just been distributing *two tons* of it among botanists, cut to size of twelve by eighteen inches. Each sheet is like a pad of blotting paper. We stitch from three to five sheets together into a dryer, the specimens being placed between successive dryers, of course enclosed in a sheet of thin soft paper; nothing can be better, nor so cheap. The maker having a small quantity left over from our large order, I have asked the Naturalists' Agency to take it in or-

der to supply botanists, schools, etc., in quantities smaller than can be had from the manufacturers. For price see the advertisement.—Asa Gray.

Late Flowering of the Gibbous Bladderwort.—This fall I found on the flats of the Charles River, *Utricularia gibba*, covering half an acre of ground in full bloom, October 2d. It continued to send up fresh flowers till cut off by a frost near the first of November. The time given in our works on botany, for expecting this little plant in flower is July and August. — Wm. Edwards, *Natick*.

New American Variety of Asplenium filix fœmina.—In Europe many variations of this fern are given in their manuals, the most prominent of which are vars. rhæticum, multifidum, marinum, crispum, latifolium.

None, however, have been noticed in this country previous to 1869, when several tufts were discovered growing in Wilton, N. H., bearing all the fronds thus peculiarly marked: tips of each pinna fringed with five to eight lobes, tops of fronds tasselled with a cluster of ten to fifteen pinnæ gradually diminishing in size towards the centre, fronds fifteen to twenty inches high, by five to seven wide. In 1870 and 1871 I gathered specimens from the same roots, in all respects like the first.

This variety seems identical with var. multifidum of English works, but as the specimen sent to the herbarium of Prof. Gray at Cambridge bears the name of *Asplenium filix fœmina* var. *cristatum*, it will henceforth be known by that name.—Wm. Edwards.

Influence of Green Light on the Sensitive Plant.— In order to test the effect of green light on the sensitiveness of the Mimosa, M. P. Bert has placed several plants under bell-glasses of different colored glass set in a warm greenhouse. At the end of a few hours a difference was already apparent; those subjected to green, yellow, or red light had the petioles erect and the leaflets expanded; the blue and the violet, on the other hand, had the petioles almost horizontal and the leaflets hanging down. In a week those placed beneath blackened glass were already less sensitive, and in twelve days they were dead or dying. From that time the green ones were entirely insensitive, and in four days more

were dead. At this time the plants under the other glasses were perfectly healthy and sensitive; but there was a great inequality of development among them. The white had made great progress, the red less, the yellow little less still; the violet and the blue did not appear to have grown at all. After sixteen days the vigorous plants from the uncolored glass were removed to the green; in eight days they had become less sensitive, in two more the sensitiveness had almost entirely disappeared, and in another week they were all dead. Green rays of light appear to have no greater influence on vegetation than complete absence of light, and M. Bert believes that the sensitive plants exhibit only the same phenomena as all plants colored green, but to an excessive degree.— A. W. B.

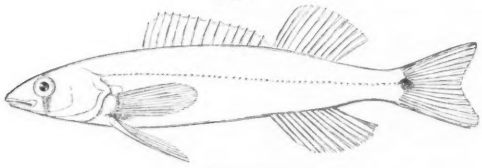
Structure of the Closed Flowers of Impatiens.—At a meeting of the Linnæan Society of London held November 16th, Mr. A. W. Bennett read a paper on the above subject, his observations, made on *Impatiens fulva* Nutt., an American species completely naturalized in several places in the south of England, being substantially in accordance with those recorded by Prof. Asa Gray in his "Genera Flora America boreali-orientalis." Mr. Bennett, however, believes that the closed or "cleistogenous" self-fertilized flowers are not the result of "arrested development," but are from the first of a different nature, and he suggests that the "cap" formed by the unexpanded calyx and corolla may be thrown off the pistil by the elasticity of the stamens, which are of a very different shape and structure from those in the perfect flowers. The anthers do not dehisce, but the pollen, the quantity of which is very small, pierces with its tubes the wall of the anther in order to reach the stigma. The plant does not appear to be visited by insects in England; the conspicuous flowers, in which there is a provision to prevent the pollen reaching the stigma consequently seldom produce pods, while the unopened flowers do so abound invariably.—A. W. B.

ZOOLOGY.

The Etheostomoids.—Having been for several years specially interested in this little group of Percoids, of which I am now engaged in completing a monograph, and wishing to secure

all the material possible before publishing the work, I take this means of asking all who are willing to give their aid to collect specimens for me. The specimens already in my hands consist of the large collections belonging to the Smithsonian Institution and the Museum of Comparative Zoology, the smaller collections of the Boston Society of Natural History and Peabody Academy of Science, and many type specimens received from Prof. Cope

Fig. 3.

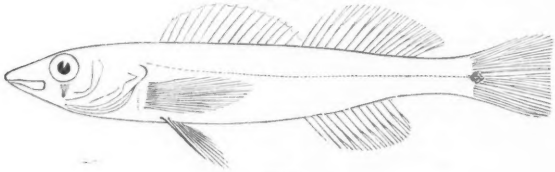


Hadropterus.

and Dr. Abbott. Besides these, all the types of Girard of the specimens described in the Pacific Railroad and Mexican Boundary Surveys, the types of Agassiz' species and such as still exist of Haldemann's and Storer's have been carefully studied. From this material about forty species have been recognized and several others are indicated by single specimens.

The great variation between individuals of the same species makes it essential to have a large number of specimens from as

Fig. 4.

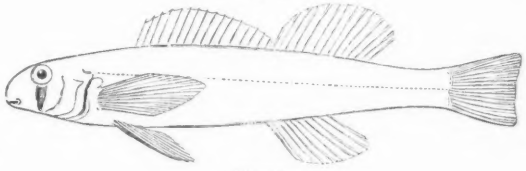


Percina.

many localities as possible in order to determine the species with any degree of certainty. Especially is this variation noticeable between males, females and young, and between males and females at the spawning time and those taken later in the season. In early spring the males of many of the species are most brilliantly arrayed in blue, orange, red, and other bright colors, while in summer and fall these colors are entirely lost or greatly changed. In many species where the males show a decided difference of

coloration from each other the females will be so similar in their plain markings as to make it almost impossible to separate them. There is also considerable variation in the shape of the fins between the males and females of some species, especially noticeable in the genus Catonotus, in which the spiny dorsal fin of the male is short and each ray usually terminates in a little knob, while in the female the rays are longer, and are without the

Fig. 5.



Hyostoma.

knob. Pages could be written on the variations which individuals of the different species exhibit when a large number of any one species has been carefully examined, but enough has been said here to call attention to the necessity of securing all the material possible for the work on which I am engaged.

These small fishes have the general appearance of young perch, and combine the habits of the perches with those of the little fresh water bull heads (Cottoids) or "miller's thumbs" as they are called in England. They are found in nearly all locations, including lakes, ponds, rivers, small streams and ditches. The sandy and gravelly shores of lakes and ponds are favorite spots, as well as the grass and weed grown shallow parts of rivers, or the clear rocky stream. Several of the species are in great part surface swimmers, but by far the larger number pass most of their time on the bottom, darting about from stone to stone or in and out among the water plants. From this habit of moving by quick, short, and often zig-zag darts they have received the common and very appropriate name of "darters," and in many localities are well known under that name. A few

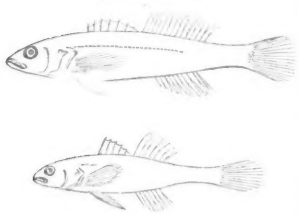
Fig. 6.

Pœcilichthys.

of the species attain four or five inches in length, but by far the larger number never exceed three inches, and many not over one and one-half to two inches. The outline cuts here given (Figs. 3–8) are all of natural size and roughly exhibit several of the more prominent forms.

These little fellows are generally quite difficult to catch until one gets familiar with their ways of darting about, but with a little practice and some patience they can be secured with a hand net or by driving them into a set net. But the way to catch them in large numbers is by drawing a seine, with very small meshes, along the banks of a lake, pond, or river, or up a narrow stream. In this way I have often succeeded in obtaining from four or five to forty or fifty specimens at a single haul of a fifty foot seine on the sandy shores of Lake Champlain. In August last, when fishing on the Wabash River, very successful hauls were made by dragging a fifteen foot seine along the shallow banks of the river over the water plants, which was easily done by one person wading up stream in about two or three feet of water, holding down one end of the seine and another person holding the seine down at the other end, in such a way as to let it bag considerably down stream, and every now and then dragging the seine ashore. In this mode of fishing care must be taken to keep the lead line well down on the bottom or the fishes will dart under. To a person who has never tried seining in this way a few hours of such collecting will secure to him more specimens of all that swim in the locality than he has thought it possible to obtain. A very successful way of collecting these darters, if you only have a scoop net, is to scoop about among the water plants, or over a muddy, leafy, or stony bottom, stirring up the bottom and getting the water so clouded as to confuse the fish, and by going backwards and forwards over the ground and every few moments emptying your net, many specimens may often be secured.

Figs. 7 and 8.



Catonotus. Microperca.

The Etheostomoids are widely distributed in the fresh waters of North America east of the Rocky Mountains, and I now have specimens taken from Hudson's Bay to Georgia. The species in

New England are very limited, only two or three having as yet been found, but in the central, north-western and southern states they are far more numerous, and the Ohio valley seems from present data to be the great centre of distribution of the group.

The method of preserving fishes is looked upon by persons not familiar with collecting as a difficult operation, and has always been a "bugbear" in the way of securing specimens of the class. I therefore offer the following simple means of preserving any small fish. If you intend collecting largely and are provided with a small seine or good hand or minnow net, it is best to go well prepared with vessels in which to place your captures, and for this purpose any strong bottles, jars or cans answer well. Pickle jars with good corks, or some of the patent preserve jars or cans are excellent, and handy to carry in basket, bag or pocket. Always, when you start out, have the collecting jars about one-third or one-half full of alcohol or unrectified whiskey (high wines), or if these can not be had readily, take common drinking whiskey or almost any spirit, as a substitute. When you get the specimens put them at once into the spirit before they have a chance to harm their fins and scales by thrashing about in the net or on the shore. It is always my plan to put the specimens I want to preserve *immediately* into my collecting jars from the net, not allowing them the slightest chance to get injured, and as the alcohol kills them almost instantly they are not harmed by dying, as is the case when left to die on land or in a pail of water as is so often done. By pursuing this course any fishes captured at the same time, and not wanted, can be returned to the river. When one wishes to study any species alive, the best way is to put two or three specimens only in a jar or pail to take home for the purpose, for if more are placed in one jar they will almost invariably die before being able to reach home with them.

While collecting you can fill your jars to the brim with specimens, provided you put them in alive and tip the jars as they are filled so that the spirits will come in immediate contact with the specimens as they are put in, but after you get home it is best either to add more spirit to the jar, or if weak spirits have been used pour it all off and fill the jar as full as you can with specimens without jamming them and then pour in all the spirits you can; tuck in a little soft paper, or rags, to stop the top ones from shifting about, and wrapping your bottles in paper or cloth put them in

a box, packing with sawdust if you can get it handy, if not with shavings, hay or grass, and send by the first express to their destination, that they may arrive before the spirits get weakened or the natural colors of the fish are lost or changed by the alcohol. As the Etheostomoids are all small fishes, common ale or junk bottles can be used in collecting or packing them up for sending away, as the specimens can be readily taken out by breaking off the neck of the bottle.

Common glycerine will answer the purpose of preserving the brilliant colors of the fishes, and it would be very desirable to have a few specimens of each kind put up in it for the purpose of making sure of the natural colors, though from its strong contracting powers specimens so preserved are not so good for general study as those put in alcohol. It would also be very desirable to have a number of specimens, especially if of brilliant colors, preserved so as to retain their colors, in the following way. Take the specimen as soon as dead and cut off a portion of one side, taking out the intestines and such of the flesh as you can take off by a simple cut, then pin it on a card, cut side down, and spread out the fins; then put on a thin coat of varnish, or, if no varnish is at hand, simply let the fish dry *in the shade*. By this simple method the natural colors will be preserved for a long time. By using a little care and putting cotton in the abdominal cavity and a little arsenic on the flesh, very handsome and interesting specimens can be made.

It often happens that a person obtains one or two specimens of a fish he would like to forward, but hardly thinks it worth while to send so small a lot by express. Such can readily be sent by mail at letter postage (three cents for every half ounce) by putting the specimens in a small tin or wooden box, with a little cotton or a rag that has been soaked in alcohol or glycerine and squeezed out (the specimen also having been first put in alcohol or spirits of some kind, or glycerine, for an hour or two). A specimen thus put up can be several days on the route without being injured.

In concluding my request for specimens of fishes of this family I beg to state that any other specimens would be very acceptable to our collection, and that any thing sent by express directed to the Peabody Academy of Science, Salem, Mass.,* will be most

*In sending specimens any express charges will be willingly paid on receipt by the Academy, and special arrangements will also be made to supply any person willing to collect for me with alcohol and jars.

thankfully received and acknowledged. I may also say that a copy of the "Monograph of the Etheostomoids," when published, will be furnished to all persons who kindly assist in the work by sending specimens; and that all notes on the habits, time of spawning, natural colors, etc., will be duly acknowledged in the work, which will form one of the series of illustrated monographs published by the Museum of Comparative Zoology. It is proposed to describe and figure every known species of the group.—F. W. PUTNAM, *Director Peabody Academy of Science*, Salem, Mass.

BUTTERFLY NOTES, 1871.—As bearing on the winter history of the species, an interesting capture of a much worn and faded female Archippus was made by me, May 12th, in this place—Amherst, Mass. The only Niphon taken during the season was found on May 18th. The 23rd, Vialis appeared and soon was very common. Phaeton was first seen June 5th, and, contrary to the usual reports, was not confined to a small locality, but became rather common in several directions from the village. June 9th, a single dimorphic female Hobomok was captured; suspecting it to be such and to have been described as Pochahontas and Quadaquina, I wrote to a distinguished lepidopterologist, who informed me that, on his pointing out the fact, Pochahontas was acknowledged by its author to be a dimorphic Hobomok; my specimen also agrees with a named Quadaquina received from a writer who has publicly stated his belief that it is the same as Pochahontas. July 8th, found Metacomet and Egeremet, males, abundant on Indian Hemp flowers and took Mopsus on an umbelliferous plant. Calanus (Westw.)—the *C. inorata* of Grote—was met with July 17th and Aug. 2nd. A single Delaware was taken by a neighbor in July. A harvest of butterflies was reaped, Aug. 2nd, on flowers of the mountain mint (*Pycnanthemum incanum*), at the foot of the Holyoke range; among them were Melinus, Mopsus, Smilacis and Edwardsii—the latter two very abundant, and the Edwardsii showing either a seasonal or regional variation from New York specimens, being smaller and the markings tending more to lines. On the top of the Holyoke range, Lucilius was frequent, and near the top a Portlandia confidently observed and the beautiful moth, *Callimorpha interrupto-marginata* taken. A visit in August to the Green Mountains in the region of Conway, Ashfield and Goshen, revealed nothing different from Amherst—none of the species that

might be set down as belonging to a Canadian fauna. The last butterfly of the season that is noteworthy was a single Milberti: frosts had come, and all the butterflies had disappeared except Philodice, rapæ and Americanus. In the course of the season, Marcia was frequent; it is not in the New England catalogue, perhaps because not regarded as distinct from Tharos. Cybele and Aphrodite were alike common, the latter the more so. A few unquestionable Cybeles had somewhat the red flush of Aphrodite. Archippus exceptionally very abundant. Graptus rare. Sassacus and Mystic common. Of the Nisoniades, some of my dates are: Lucilius, Ennius, Juvenalis and Persius, May 27th— the first also August 2nd, and the second also June 10th; Icelus, June 3rd and Horatius July 24th. The following New England butterflies have not been observed: Protodice, Eurytheme, Lisa, Delia, Genutia, Epixanthe, Porsenna, Lucia, Clothilde, Acadica, strigosa, Augustus, Henrici, Atlantis, Montinus, Claudia, Nycteis, Harrisii, Cœnia, gracilis, Faunus, Semidea, Bachmanii, Catullus, Lycidas, Verna, Wingina, Acanootus, Manataaqua, Manoco, Hianna, Panoquin, Mesapano, Logan.—H. W. Parker.

Iowa Butterflies.—To the lists hitherto published are to be added Phaeton, Acadica, Thoe, and the following Hesperians: conspicua, Otho, Zabulon, Massasoit, Poweshiek,—all from Central Iowa, namely Poweshiek and Jasper counties.—H. W. Parker.

Young of the Blind Fish.—Dr. Hagen gives me the following information about the young specimens I mentioned (page 15) as belonging to Dr. Steindachner, which I just missed seeing before they were sent to Vienna. These specimens were procured by Dr. Hartung for Dr. Steindachner under the following circumstances. Just as Dr. Hartung was leaving the cave hotel on Oct. 21, a bottle was brought to him containing four specimens, one of which was smaller than the others (probably Typhlichthys), all living. He immediately transferred them to a jar containing alcohol and took no notice of them until he reached Nashville, when he discovered an addition of *eight little ones* in the jar.

The birth of these young was undoubtedly due to placing the parent in the alcohol, and the date (Oct. 21) would correspond to the time I stated in my paper as probably that at which the young were born.

Dr. Hagen states that he examined the young under a lens with-

out taking them from the jar and *could not discover any eyes*. The specimens were about three lines in length.

So now we have two more facts to add to the history of the blind fishes (though whether they apply to Amblyopsis or Typhlichthys is not yet settled). First, that the young are born in October, and second, that they are without external eyes when born. — F. W. Putnam.

GEOLOGY.

Geology, etc. in California. — At the regular meeting of the California Academy of Sciences Dec. 4th, Professor Whitney presented a variety of fossils found in limestones one hundred miles east of Elko. He then read a paper descriptive of his labors in the projection of a topographical map of the State, and exhibited several proofs or specimen copies to the members. They were most complete and elegantly engraved. He had commenced the publication of a volume on the geology of the State, and would probably compile three on the same topic. He also exhibited the first volume of the "Birds of California," containing seven hundred illustrations. This, the first volume, was devoted to the land birds of the state. The "Botany of California" was also in preparation. It is not to be illustrated. Salvador Morthange, consul-general of Belgium, was introduced to the Academy and read a highly interesting paper on White Island, in the bay of Plenty, New Zealand.

Professor Marsh, of Yale College, made a few remarks on his recent explorations. He had been out since June from New Haven, and had spent two months in collecting vertebrate fossils. He had discovered probably about fifty new species from the Miocene and Pliocene deposits, embracing a large variety of extinct reptiles. In Eastern Oregon he had made discoveries which would seem to clear up the geological puzzle in regard to the fresh water lakes; and also a large number of fossil horses, some but two feet in height, and some of the two-toed type had been collected.

Dr. Blake read a paper on the water of the "Devil's Inkstand," at the Geysers, which he found to contain a large quantity of ammoniacal salts. — R. E. C. S.

Origin of the New England Glacier. — Professor Dana contributes an important article to the "American Journal of Science"

on the icy plateau which gave rise to the great New England glacier. He locates this *mer de glace* between Lake Temiscamang and Lake Mistissinny, on the Canadian watershed. During the glacial period the watershed was probably five thousand feet above its present level, while the White Mountains, the Green Mountain peaks, and the Adirondacks stood five hundred feet higher than they do at present; so that there was a sufficient inclination toward the sea-coast to allow of a movement in a southeast direction of the mass of ice.

ANTHROPOLOGY.

Scalping.—The "Friend of India" contains a letter from the Superintendent of Police in the north-eastern district of Bengal, giving an account of *scalping* among the wild tribes on the frontier of that district. In commenting on this letter the journal above named says, "The Naga tribes use the scalping-knife with a ferocity that is only equalled by the American Indians, and the scalps are carefully preserved as evidences of their prowess and vengeance over their enemies. On the death of a chief, all the scalps taken by him during his warlike career are burned with his remains."—*Jour. Anthr. Inst. N. Y.*

Archæological Chronology.—According to a notice of his "Essai de Chronologie Archéologique" in "Pall Mall Budget," Professor Forel draws a vivid picture of the time which has elapsed between the deposition of the Schussen glacial beds and the earlier lake habitations. A lapse of time of unknown duration had passed away, and at the commencement of the lacustrine epoch the following changes were accomplished. The fauna had changed. The reindeer and the mammoth had passed away, the *Bos primigenius* alone surviving as a contemporary of the wild boar, red deer and roebuck. The flora had changed. To the Alpine flora, with its scanty vegetation of mosses and lichens which were just able to grow on the ice-mud, had succeeded rich and brilliant forests composed of all our indigenous species of trees. The level of the lake had fallen 30 mètres, and had assumed its present aspect. And man seems to have changed from the poor reindeer hunter of the Salève to the intelligent and active fisher, agriculturist and manufacturer, to whom are due the relatively highly civilized lake habitations of ancient Switzerland. But the use of metal had not been introduced yet, and pottery alone indicates the comparatively high grade

of civilization at which the builders of the *pfahlbauten* had arrived. Long after came the ages of bronze and iron, and finally the Roman period, with its fixed dates and absolute chronology. A rapid review of the history of humanity in Europe shows us an uninterrupted series of events, looking back from the Roman period, through the various lacustrine epochs as far as the most ancient remains of polished stone. But there occurs a gap. We are not in presence of fixed dates, and the continuity of the events alone gives us a perfect key to their relative antiquity. Professor Forel asks—has this lacuna lasted a hundred years, a hundred thousand, or millions of years? And, while he does not attempt to precisely estimate its duration, he proves convincingly that the gap is considerable, but that it is not enormously large. The age of trees which must have grown in the rich vegetable beds of Morges, after mould had been slowly formed from the débris of the pebble beds of the glacial period, indicates a vast lapse of time. Professor Forel enters at great length into certain results at which he has arrived after sounding the Rhône at various levels, and precisely estimating the amounts of mud which the river annually transports. He considers that a space of 300,000 years is necessary in order to fill the lake of Geneva, and that in time the lake will be entirely filled up. His conclusions, in fact, are that the space of time which separates the archæological ages of the reindeer and of the red deer (palæolithic and neolithic epochs) is considerable, and ought to be counted by thousands of years; it is not infinitely great, and ought not to be counted by millions of years.

MICROSCOPY.

"Power" of Lenses.—For some three or four years some American microscopists have been calling attention to the "deception" commonly practised by most working opticians in calling the "power of their instrument less than it really is—*i. e.*, calling an objective a quarter-inch when its focus is really but one-fifth or one-sixth of an inch—or an eighth when actually a "one-ninth or one-tenth,—and some now approach to one-twelfth."

In the "Monthly Microscopical Journal" for December, 1871, Mr. F. H. Wenham writes a paper in reply to one of Mr. E. Bicknell's on this subject in which he takes Mr. Bicknell to task for exposing the deception,—and admits the truth of the charge.

Here we have a gentleman, well known throughout the microscopical world as one of the most accomplished *theoretic opticians* of London, generally supposed to be the principal advisor of the working opticians, not apologizing for, but practically defending the imposition, one that has been exposed and complained of by Dr. Wm. B. Carpenter* and also by a writer in the "Quarterly Journal of Microscopical Science."

Mr. Wenham says "a scientific microscopist gives the diameters with his illustrations and the nominal power of his object glass; this quite meets the case." In this Mr. Wenham is entirely wrong; it does not meet the case. A power of one-thousand diameters obtained with a one-inch objective is a very different thing from one-thousand diameters obtained with a one-tenth, *unless the one-inch is ten times as good an instrument as the one-tenth.* The scientific microscopist should give with his illustrations, not only the amplification he employed, but the real focus of the objective, and the name of the maker, as astronomers do in the case of their telescopic observations.

He farther says, "in such a difficult and complex arrangement as a high power object-glass, it is almost impossible for all the makers to work to the same magnifying standard." That of course depends on the knowledge of optics possessed by the workman, but has nothing to do with the matter. When the object-glass *is made*, the focus can be measured, and the glass named accordingly. The nearer the actual power comes to that intended, so much the more credit to the maker — the farther it is from what he sells it for the more to his discredit. It is an axiom in microscopy that the lower the power of a glass that will give a certain result or effect, the better the glass.

Mr. Wenham's comparison with the steam engine is as inappropriate as Hartnack's objection to English microscopes, that with their wheels and screws they look like a steam engine.—C. S.

PHOTOGRAPHIC MICROMETER AND GONIOMETER.—J. C. Southworth, of Georgetown, D. C., proposes, in the "American Journal of Science and Arts," a photographic positive on glass as a substitute for the ruled micrometers. Lines of one-sixth inch interval are reduced by photography to $\frac{1}{250}$ inch, mounted in balsam, and used like the ordinary eye-piece micrometers. The lines are black

*The Microscope, etc. London. 1868. p. 181.

and distinct and the intervening spaces are said to be sufficiently translucent, which would suggest that the contrivance is best suited for the rapid and easy performance of easy work.

Similarly a goniometer is made by reducing a graduated circle of eighteen inches to a transparent positive of suitable size to be placed in the draw-tube below a positive eye-piece. The eye-piece is furnished with a cob-web line, and its rotation is easily read off on the scale in its focus. This goniometer, which could be made for a few shillings, would seem to be a valuable accessory to all microscopes, especially to those not possessed of a graduated concentric stage.

THE DIATOM HOAX.—Many readers have enjoyed, in a late medical journal, the ingenious essay on test-objects, in which the new immersion one-seventieth of 191°, wet with fluoric acid and illuminated by a new eccentric parallelopiped with fluorescent rays exclusively, is represented as revealing that the structure of *Pleurosigma angulatum* is like the Nicholson pavement; and that a new diatom, fortunately rare, has beads, more than one hundred and forty-seven millions to the inch, which are invisible by all other lenses and to all other observers. They will be further amused by learning from the "Boston Journal of Chemistry" that some foreign medical journals have seriously reviewed this burlesque and discovered it to be a hoax.

THE RED BLOOD-CORPUSCLE.—Mr. E. Ray Lankester presents in the "Quarterly Journal of Microscopical Science" an interesting contribution to our knowledge of the physical structure of the red blood-corpuscle and the action of gases and vapors upon it.

The red blood-corpuscle has no outer coat distinct from its contents and having a pronounced inner limitation, none being visible under the highest powers of the microscope (what might be mistaken under low powers for such proving under high powers to be an illusion of refraction), and the corpuscles, torn or cut by drawing a needle across the slide, suffering no escape of viscid material from their interior, but furnishing portions which by the collapse of their edges assume a rounded form; yet their surface must be differentiated into a film or pellicle having no definite inner boundary, and similar to the pellicle which forms on a cooling mass of jelly, since they become wrinkled when subjected to oblique pressure and recover their form and outline again with great elasticity and precision.

The stroma of which the viscid mass mainly consists appears homogeneous in the mammalia, but contains a nucleus in the other vertebrata. This nucleus, though undetected by Savory, seems to exist in perfectly fresh corpuscles, and has been detected in blood while circulating in the vessels of the frog. It is somewhat indistinct, though a temporary delimitation may be caused by certain physiological conditions of the animal, and after removal from the circulation it becomes sharply and permanently defined.

The usually described forms characteristic of certain classes of animals, are not believed to be the only normal forms. The blood of the frog seems to vary at different seasons of the year, and the ordinary biconcave discs of human blood may be more or less replaced, in fresh and perfectly healthy blood, by the "thorn-apple" and the "single" and "double watch-glass forms."

The macula discovered by Dr. Roberts of Manchester in the blood of all vertebrata are strangely ignored by most of the recent authorities, though published many years ago. They are fully verified by the author's researches. A part of the matter composing the corpuscle segregates to form spots, usually one in man but often three or four in the frog, which are ordinarily imperceptible, but which are deeply stained by nitrate of rosanilin, and form sharp little pullulations under the influence of tannin. Whether the development of these macula is *post-mortem* or not seems to be undetermined.

That the corpuscles are not in the condition simply of a moistened membrane is shown by the very curious observation that they will readily float out of the plasma into a drop of oil. When separated in this manner from the plasma they show a strong tendency to cohere and thus assume hexagonal forms, just as they sometimes do when a thin film of blood is dried upon a slide.

The appearance and disappearance of the granulation of the nucleus and other effects demonstrated by Stricker to take place when blood, after contact with aqueous vapor, is exposed alternately to carbonic acid and atmospheric air, is proved to be due to the alternate presence and absence of the carbonic acid, and not in any part to the oxygen of the atmosphere, since the air may be replaced in the experiment by hydrogen or other gases.

The action of chloroform and many other re-agents upon the corpuscles is studied minutely, but without as yet throwing the desired light upon their effects when introduced into the living system.

The preservation of blood absolutely unchanged in appearance is essential to a successful study of its structure. Hitherto the inadequacy of most students' microscopes and the necessity for immediate and hasty inspection of blood has almost prevented its successful study. To these reasons it should be added that only the few students who make somewhat of a specialty of this branch of science can become sufficiently expert for its more difficult investigations; and the author's estimate of drying as a means of preserving blood, that it is of little or no use, meets with an important exception in the case of studies as to the class of animals to which a given specimen of blood belongs, and also in the determination of the existence of certain diseases. For all purposes, however, it is desirable to preserve the corpuscles in their natural state, and osmic acid has been successfully introduced for this purpose by Prof. Max Schultz. A film of blood on a glass cover is exposed for three minutes to the vapor arising from a bottle of two per cent. solution of osmic acid; after which it may be immediately mounted in a nearly saturated solution of acetate of potash. "Every corpuscle thus becomes 'set,' as it were, in its living form."

A New Group of Infusoria.— In studying the blood of frogs Mr. E. Ray Lankester has sometimes noticed a little parasite which was at first mistaken for a very active white blood-corpuscle. This new infusorian, which is figured in the "Quarterly Journal of Microscopical Science" for October last under the name of *Undulina ranarum*, is a minute pyriform sac, the narrower end of which is somewhat twisted and spirally bent round upon itself, giving it a strikingly shell-like appearance. It has neither mouth nor cilia, but instead of the latter a broad, toothed, undulating membrane which makes it the type of a new group of infusoria.

Structure of Minute Organisms.— The "New York Evangelist," in describing with very natural admiration the beautiful Moller's Type Plate (the *diatoms* of which, by the way, are undoubtedly vegetable and not animal organisms), raises again the question whether these minute organisms may not be possessed of organs and tastes corresponding to those of higher aminals. Persons having an intelligent interest in the science of microscopy, but unfamiliar with its details, cannot be too well assured that the extreme simplicity of the lower organisms is a fact of positive,

not of negative, knowledge, — a conclusion reached from what we see, and not from what we fail to see.

PURE WATER. — Dr. Burdon Sanderson, F.R.S., found it impossible to obtain optically pure water. The fusion of ice furnished the nearest approach to this standard.

RAILWAY DUST. — The "Manchester Guardian" publishes a study of railway dust made by Mr. J. Sidebotham, who finds it to consist, in the case examined, about one-half of particles of iron, and the other half of cinders, sand, etc. Some of the particles of iron were magnetic, and most were sharp, rough and irritating.

NOTES.

WE make the following extracts from a letter to one of the editors from Mr. Dall, Chief of the Coast Survey Expedition to explore the hydrography and natural history of Alaska. It is dated Harbor of Iliuliuk, Unalashka, Alaska Terr., Oct. 30, 1871:

"We arrived here on the 23d of September after a disagreeable passage of twenty-six days from San Francisco, during which, however, we obtained some very interesting observations on the currents. We have been very busy since we arrived, and have accumulated abundance of material to keep us busy all winter, both in regard to Natural History and Hydrography. This harbor is a fine one, and we have a chart well under way and hope by spring to have it approximately complete. Tidal and current observations are going on, we have taken many hundreds of angles and shall go to sounding bye and bye.

The island when we came was a mass of verdure up to the snow caps of the highest peaks. There are no trees, except half a dozen planted by Veniaminoff, the apostle of the Aleuts, in 1805. They are Sitka spruce, very stout and thick, but only about fifteen feet high. The indigenous shrubs and willows are seldom more than six feet high and an inch or two thick. I went on an exploring trip the other day in the interior of the island and with the exception of some wood which we packed on our backs for kindling, we had to boil our tea with green huckleberry bushes! But the herbage is very rich and rank. Sheep and pigs do exceedingly well here with less care than they need at home and I believe hardy cattle would do the same. The winter is wet and windy, but not cold; there is a good deal of snow but it melts very quickly after it falls and rarely lies on the ground any length of time except in severe seasons. The waters abound with fish but there are no land animals, except spermophiles and foxes. Whales are very

often seen inside the harbor. Birds are rather plenty at this season and probably much more so in summer.

This month and the next are the worst of the year. We have had more or less rain almost daily, but also a good deal of sunshine, more indeed than I anticipated. The weather has been comfortable, temperature averaging 44° Fahr. It has not been lower than 32° yet and that only once, still the snow has crept down the mountain sides a thousand feet and we have had several real old fashioned snow storms.

All hands have worked together harmoniously and with energy. I think the prospects for a good season's work are very favorable." —Wm. H. Dall. *Actg. Asst. U. S. C. Survey.*

T. Sterry Hunt, LL.D., chemist to the Canadian Geological Survey, has been appointed to the chair of Geology in the Massachusetts Institute of Technology.

Some one writes to "Land and Water" that though the menagerie at the Jardin des Plantes is at a low ebb, still specimens are being forwarded by the various agents with all speed, and we may hope soon to see it with some of its former glories.

Prof. C. F. Hartt has recently returned from his explorations in Brazil, having specially studied the supposed Amazonian drift beds; and Prof. Marsh has returned to New Haven, with immense collections of fossil vertebrates, etc., from the Rocky Mountains.

Prof. H. James Clark, of the University of Kentucky, has been appointed Prof. of Veterinary Science in the Massachusetts Agricultural College.

Dr. G. Hartung, the well known geologist and author of the splendid works on Madeira, Lancerota, Teneriffe and the Azores, has recently made a geological trip through this country, so as to be able the better to study American works on geology. We also learn from Prof. Hagen that two other German geologists of good reputation, Drs. Reiss and Stuebel, authors of works on Teneriffe, and Santorin, have been geologising for two years past on the west coast of South and Central America, and travelling thence from New York to California, design to go to the Hawaiian Islands to investigate their geology with a view to publication.

How interesting a collection illustrating the products, habits and homes of insects, as well as the relations of zoology and botany to agriculture and the arts may be, is to be seen in a visit to the Museum of the Agricultural Department at Washington, the

result of many years' work of Mr. Townend Glover, to whose unrequited labors in practical entomology we have previously called attention.

He has a beautifully illustrated manuscript work on the insects injurious to cotton and other crops, which thus far Congress has been asked in vain to publish. To the great value of the museum Prof. Hagen of the Museum of Comparative Zoology at Cambridge bears the following testimony. "I find no notice in the NATURALIST of the Museum of the Agricultural Department in Washington, D. C., the admirable work of Mr. T. Glover. I was really astonished at going through this valuable collection. The plan upon which Mr. Glover works is his own, and the arrangement of his own devising. When fish, fruits, etc., cannot be preserved, excellent casts beautifully colored are made and exhibited. Plates illustrating injurious and beneficial insects and their transformations, drawn, engraved and colored with his own hand, are mounted in the halls,so that if any one wants to know about the insects injuring certain crops or plants, he can obtain very complete information. I know not which the more to admire, the extensive, really vast plan of the institution, and the elegant completion of the design, or the modesty of the learned naturalist who has conceived and done it all entirely without aid, in the agricultural interests of this great country; meanwhile supported by means really ridiculously small, compared with the results. I confess that the Agricultural Museum in Washington has no superior in the world, and even no rival either in England, France or Germany."

THE authorities of Brown University are beginning to form a museum of natural history. During the last year several additional large cases were placed in Rhode Island Hall, and between three and four hundred specimens of birds and animals were added to the previous collection. A large collection of the implements of American Indians was also added, together with several small though valuable collections of coins, both ancient and modern. The expense incurred by these improvements was met by a few friends of the College, interested in this department. Arrangements have now been made for adding to the Cabinet an extremely valuable collection of birds, numbering about forty-five hundred; and also such specimens in Mammalogy, Herpetology, Ichthyology, Conchology and Comparative Anatomy, as will meet the wants of instruction.

The mounting and arrangement of the specimens is entrusted to the care of Mr. J. W. P. Jenks, A.M., a well informed practical naturalist, and a most skilful taxidermist. Mr. Jenks was one of the party assembled by Prof. Baird, U. S. Fish Commissioner, at Wood's Hole, during the last summer, and spent six weeks in making full collections of the marine animals of that coast, so that this department usually so incomplete in our colleges, will be well represented at Brown.

Among the losses sustained by the burning of the Museum of the Chicago Academy of Sciences was that of "the State collection of insects, recently purchased by the State from the heirs of the late State Entomologist, Mr. B. D. Walsh, for two thousand dollars, but of great scientific value from the number of types it contained.

"The Smithsonian collection of Crustacea, undoubtedly the largest alcoholic collection in the world, which filled over ten thousand jars, and contained the types of the species described by Prof. Dana and other American authors, besides hundreds of new species, many of which were described in manuscripts lost by the same fire.

"The invertebrates of the United States North Pacific Exploring Expedition, collected in great part in Japanese seas by the Secretary in 1853–56, which, besides crustacea, included in the last item, embraced great numbers of annelides, mollusca, and radiata, most of which remain undescribed, except in manuscripts also lost.

"The collection of the marine shells of the coast of the United States, made by the Secretary and his correspondents during twenty years of dredgings and general research on every part of the coast from Maine to Texas. Nearly every species was illustrated by specimens from every locality in which it occurs, not only on our own shores, but on those of Europe and the Arctic Sea, and in the Tertiary and Quaternary formations, showing the effect of climatic influences, geological age, etc. This collection embraced about eight thousand separate lots of specimens.

"The deep-sea crustacea and mollusca dredged in the Gulf Stream by M. Pourtales, of the United States Coast Survey, in the years 1867, '68 and '69, which had been placed in the hands of the Secretary for description.

"The manuscript of the Invertebrate Zoology of the North Pacific Exploring Expedition under the command of Capts. Ringgold and Rodgers, in 1853–56; the shells by the late Dr. A. A. Gould; the Crustacea, Annelida, Nudibranchiate and Tunicate Mollusca, Holothurians and Starfishes, by Wm. Stimpson. These manuscripts were illustrated by nearly three thousand drawings by A. Schœnborn and W. Stimpson, many of which were colored. This material was awaiting an appropriation from Congress for publication. A portion thereof (that on the Brachyurous Crustacea) was

saved, having fortunately been in the Smithsonian Institution at the time of the fire.

"The manuscript of the work on the shells of the East Coast of North America, prepared for the Smithsonian Institution by W. Stimpson, illustrated by drawings not only of the shells, but of the soft parts, lingual dentition, ova-capsules and other details. This work had been in course of preparation since 1849, and many of the species illustrated were new to science. About two hundred of the drawings had already been engraved on wood, but the blocks were destroyed with the rest of the materials. That portion of the work containing the synonymy of the species already described was saved, having been in the house of the Secretary at the time of the fire.

"The manuscripts and drawings of a work on the Crustacea of North America, in preparation for the Smithsonian Institution by Wm. Stimpson. A series of "dredging papers," containing an abstract of the result of explorations by the Secretary on all parts of the coast from Nova Scotia to Florida, and in the Gulf of Mexico, chiefly valuable for the study of geological and bathymetrical distribution. The descriptions (as far as completed) of the deep-sea crustacea and mollusca dredged in the Gulf Stream by M. Pourtales, prepared by the Secretary. A portion of these descriptions had been published in the 'Bulletin of the Museum of Comparative Zoology.'"

BOOKS RECEIVED.

On the Position and Height of the Elevated Plateau in which the Glacier of New England, in the Glacial Era, had its origin. By J. D Dana. 8vo. pp. 8. 1871.

Maps of the Upper and Lower Geyser Basin, Fire Hole River, Wyoming Territory, and of the Yellow Stone Lake. From Surveys under the Department of the Interior. By U. S. Geological Survey under Dr. F. V. Hayden.

Preliminary Report on the Dredging in Lake Superior, under Bvt Brig. Gen. Comstock, U. S. A. By Sidney I. Smith. 8vo. pp. 8.

Monthly Report of Dept of Agriculture for Nov, and Dec. 1871. [Contains "Entomological Record." By T. Glover, U. S. Entomologist.]

Alcyonellidæ and Cuticles Recent—Americanæ. By Stephen T. Olney. Providence. 2 pamphlets 8vo. 1871.

Conchological Memoranda No. 8. By R. E. C. Stearns. San. Francisco, p. 1. 1871.

Bulletin of Museum of Comparative Zoology. Vol. 3, No. 3. Letter concerning Deep-Sea Dredgings. By L. Agassiz. pp. 5. 1871.

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Report on the Geological Structure and Mineral Resources of Prince Edward Island. By J. W. Dawson, assisted by B. J. Harrington. 8vo. pp. 92. Map and 3 plates. Printed by authority of the Government of Prince Edward Island. Montreal 1871.

Descriptions of New Species of Birds of the Families Troglodytidæ and Tyrannidæ. By George N. Lawrence, pp. 5. 1871.

Catalogue of Crustacea from Panama collected by J. A. McNeil. By T. H. Streets. pp. 6, 1871.

Das Gräfenthaltal Gauernitz. By Dr. L. W. Schaufuss. 8vo. pp. 24. 1871. Dresden.

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Verhandlungen des Naturhistorischen Vereines der preussischen Rheinlande und Westphalens. 1870. 1 vol. 8vo. Bonn.

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Proceedings Academy Nat. Science of Philadelphia. Part 2, Apr.–Sept. 1871. (Jan. 1872.)

A series of papers on Cucholoan and Geology. By Isaac Lea, from the author.

Bulletin of the Torrey Botanical Club.
Journal of the Franklin Institute. Jan.
Amer. Journal of Science and Arts. Jan.
Land and Water. Nos. for Dec.
The Academy. Nos. for Dec. Jan.
La Frawce Scientifique. Nos. for Dec.
Rowdon Scientific Review. Dec., Jan.
Le Naturaliste Canadien. Dec.
Nature. Nos. for Dec. Jan.
The Field. Nos. for Dec. Jan.
Science Gossip. Dec. Jan.
Newman's Entomolyist. Dec. Jan.